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THE INTERNATIONAL ELECTROTECHNICAL COMMISSION AT BRUSSELS

On another page we print an account of the proceedings of the recent "réunion amicale" of the International Electrotechnical Commission at Brussels. The reason for holding a reunion this year, instead of a plenary convention, was that at a convention the proceedings are necessarily of a formal and rigid character, in which definitely prescribed resolutions are either voted or rejected; whereas, at a reunion, the resolutions are not final, so that much greater freedom of discussion and of proposals naturally exists. The reunion just held has been a great success for all parties concerned, and especially for the electrical engineering institutions of the United States. Four subjects were discussed by the reunion, namely, nomenclature, symbols, vectors, and rating of machinery. The suggestions for the last three emanated, in considerable measure, from the United States committee, which fortunately was represented at the meeting by Dr. A. E. Kennelly, its president. All four subjects were dealt with in a definite and satisfactory manner, constituting a basis not only for a final vote in plenary session next year, but also for steadily maintained advance along the lines selected.

In the matter of nomenclature, a list of some 80 equivalent terms in the German, French and English languages has been recommended; while a committee of three delegates has been ordered for continuing the work. In the matter of symbols, the list submitted by the United States committee has been recommended for international adoption, with only minor modifications. As regards the direction of rotation in vector diagrams, the reunion voted to undertake an examination of the question, with a view to arriving at a final vote next year as to which direction should be internationally adopted. This will be a boon to a great number of technical men and electrical engineering students, by bringing to a close, in all probability, the useless and wasteful existing dissension between different textbooks on alternating-current phenomena. It is expected that the central office of the commission in London, will shortly invite all of the local committees to communicate briefs on either side of this vexed question, and that these briefs will be mutually interchanged in such a manner that the delegates at the next plenary convention may meet fully prepared to vote upon the subject. Assuming that this decision is satisfactorily reached, it will probably carry sufficient weight to bring all subsequent publications into conformity, a benefit that would alone justify the existence and organization of the commission.

With regard to the rating of machinery, no great advance in detail can be expected internationally for the present, because the subject is so involved, and because the sets of standardization rules adopted by the various national electrical engineering bodies differ so materially in minor matters. A great step has, however, been made in arriving at a resolution that the output of all machines, whether dynamos or motors, should be ex-

pressed in watts. Hitherto, it has been customary for engineers in all countries to express generator outputs in watts, but motor outputs in horse-power, cheval-vapeurs, poncelets, or watts. It is not to be expected that a resolution of this kind will instantly take effect, or that we shall see the rating of moors in horse-power speedily disappear from the electrical engineering industry; but it is to be expected that, if this resolution is ratified next year, there will be a tendency on the part of engineers everywhere to drop the term horse-power in motor ratings, so that in time this term will disappear. There can be no doubt that from an electrotechnical and engineering standpoint, outside of the domain of the physicist, the Brussels reunion will be regarded as the most important international event since the international electrical congress of St. Louis in 1904; and it is to be hoped that even better success will by this reunion be insured for the plenary convention of 1911.

THE MICHIGAN ELECTRICAL CONVENTION.

The convention last week of the Michigan Electrical Association was, as usual, marked by excellent discussions on the floor, and a social atmosphere that conduced to the exchange of experience among the attendants. The subject of rates at any electric light convention never fails to stir up a discussion. At Port Huron the usual animation with which this subject is taken up was increased by the injection of certain ideas favorable to flat rates, which were vigorously opposed by some members. A few years ago it would have been difficult to find anyone who would get up and defend the flat-rate system of charging for anything but a central-station operating by water-power with an ample supply of water. In recent discussions, however, it is notable that some of those most favorable to flat-rate ideas are among those who have given intelligent thought to the rate question. The truth is that the advent of the tungsten lamp has utterly unsettled former opinion as to rate systems, and the subject has reverted to the stage that existed 15 years ago. We are now in a transition period, and while the current proposals and discussions of rate systems are of the highest interest, the central-station man should for some time to come reserve final judgment as to which of the numerous proposals constantly being made really shadows a permanent solution.

The real point at issue in the discussion which took place in the Michigan convention was not whether it is advisable to go back to the old flat-rate system of charging for all customers, but whether there is not a certain field for a flat rate alongside systems using watt-hour meters. It is well known that consumers on the flat-rate basis are likely to abuse their privileges, not only by waste of electricity, but by substituting larger lamps than those they have contracted for. To overcome these difficulties it is contended by some that the rate must be high enough to leave a profit for the company even with considerable waste of energy; and if the system is put into extensive use among small consumers, some appliances for controlling the maximum demand should be used, which cannot be tampered with by the consumer without detection. With carbon lamps a rate high enough to make the company safe against loss would necessitate a cost too high for the small consumer whom it is desired to attract by means of the flat-rate proposition. With tungsten lamps, and especially with the tungsten lamps of 16 watts to 25 watts consumption, a rate may be made high enough to protect the company and at the same time low enough to attract the small consumer. In fact, to the central station the attractive feature of the controlled flat rate as it is now being tried in a number of the cities is the high gross revenue which it brings per kilowatt of maximum demand. A rate of 1 cent per month or 12 cents per year per watt of demand contracted for is the equivalent of $120 per kilowatt of demand per year. There are very few consumers on the average lighting company's mains who yield as high a revenue as this, the average usually falling between $65 and $75 per kilowatt of station capacity, in which allowance should be made for losses between the consumer and station busbars.

It has been proposed frequently of late that rates be readjusted in anticipation of the menace of low-candle-power tungsten lamps so as to require higher fixed charges per consumer and per kilowatt of maximum demand, at the same time lowering the kw-hour rate. It is but a short step from this with small residences to wiping out the kw-hour rate altogether and basing the charge on maximum demand entirely, the latter being, of course, the controlled flat-rate system. The question thus set for companies to decide is whether the flat-rate system will not be sufficiently accurate for the class of small residence consumers from whose business companies fear loss of revenue with the introduction of low-candle-power tungsten lamps. As far as the larger consumers are concerned, the use of heating appliances and the more liberal use of light and motors will doubtless counteract any bad effect on the revenue. In passing it may be remarked that the entry into the field of low-candle-power tungstens has plainly aggravated a situation which was being satisfactorily settled on the basis of "more illumination for the same money." It has been well demonstrated that the old-fashioned flat-rate system is not satisfactory or equitable for general application over a central-station company's entire system, because it ignores the variable kw-hour expenses. On the other hand, the uniform meter rate of so much per kw-hour, which originally took its place, is unfair and unsatisfactory because it ignores the element of fixed charges which are dependent on the size of the consumer's installation and the number of hours per year he uses it. It would appear that the coming successful system of rates must take into account both these elements. As President Marshall said in closing the discussion at Port Huron, those building rate systems should first of all recognize the three factors—kw-hour, maximum demand, and consumer costs—which enter into the expense of serving any consumer; and if once these are fully recognized and reckoned with, the exact form or name of the rate system is not of so much consequence. It is quite possible that for some conditions a flat rate with suitable control of the maximum demand will approach near enough to an equitable rate to be advisable. Under other conditions it is manifestly impracticable.

SAFE ILLUMINATION.

Of late much attention has been directed to the problems of ocular hygiene, and attention should be directed to a long investigation recently brought to the attention of the French Ophthalmological Society by Professor Gariel. It is a study of the effects of artificial light upon the eye, with special reference to the ultraviolet radiation to which many injuries to the eye have been ascribed, perhaps with some lack of discrimination. There is no doubt that certain radiations of very short wave-length may do serious mischief to the visual organs, but it is hardly clear as yet that one can definitely assign to a par-

ticular region of the spectrum all the troubles to which the eye falls victim. In drawing up an indictment of the ultraviolet, some counts against the visible spectrum may probably be found. There is no doubt at all that serious damage may also follow too long or too energetic exposure of the eye to ordinary light. After every solar eclipse oculists have occasion to treat a certain number of cases of grave injury due to overexposure of the eye to the solar rays, either directly or with intensity enhanced by the use of telescope or field glass. Some of these cases involve merely inflammation and temporary scotoma; others a permanent scotoma, the retina being locally damaged beyond repair by the violence of the photochemical action produced. Now such injuries must be charged to ordinary light, since in the first place a telescope objective presents a sufficient thickness of usually dense flint glass to block the ultraviolet rays, and, second, the permanent damage is retinal, while there is considerable evidence ably marshalled by Dr. Gariel to show that the media of the eye themselves absorb the ultraviolet rays. Moreover, there are numerous cases in which serious permanent damage has been done by the persistent glare of an incandescent lamp filament, the light from which is notoriously weak in the ultraviolet, and, moreover, is already filtered through the lamp bulb. It is unsafe to work long about an electric arc, even when the eyes are protected by glasses quite competent to cut off totally the extreme ultraviolet. In other words, there is not the slightest doubt that the eye can be injured or ruined by too great access of energy in the form of ordinary light, and that the damage thus done is quite as much to be feared as that produced by any other form of radiation. We lay special stress on this phase of the matter since the tendency of some of the recent literature has been so to accentuate the dangers of the ultraviolet as to withdraw attention from the ever-present risk of injury from ordinary glare.

Professor Gariel in taking up the study of the effect of the shorter radiations directs especial attention to the way in which they are absorbed by the crystalline lens of the eye, an absorption which is very plausible and believed to lead to its damage. He gives a résumé of the very interesting studies of Chardonnet, Gayet and others on the aphakic eye—that is, lacking the crystalline lens—indicating how this lens strongly absorbs the rays transmitted by a thin silver film while the other media of the eye transmit them. For this reason the aphakic subjects could see the ultraviolet rays from the electric arc. Gayet in particular went further and showed that the young eye of a ten-year-old subject possessed still a lens transparent enough to see the arc through the silver filters. In later life the lens grows yellow, so that in the case of the old it is not easy to see the H and K lines of the solar spectrum. In this case, nearly the whole ultraviolet must be absorbed, so that the rays of wave-length just outside the visible spectrum may still be culpable. Glass workers' cataract, for example, seems quite as likely to be due to these supposedly harmless rays as to those further in the ultraviolet, which must be relatively weak at the temperature of molten glass. Too great an access of energy to the eye is dangerous to a high degree, whatever its wave-length.

There is undoubtedly, however, a type of injury somewhat resembling an X-ray burn which is specifically due to rays in the extreme ultraviolet, probably of wave-length 300 $\mu\mu$ and below. The effect is a very characteristic one in that it comes on violently some hours after exposure; and while producing great pain and severe inflammation, it affects the frontal media of the eye, rather than the retina, and in all but the severest cases ends in complete recovery. It is this type of injury that has in a number of cases been received from the quartz mercury lamps. Slightly colored spectacles seem competent to cut off the injurious radiations and to enable the patient to go back to his occupation under the quartz arc with impunity. Save for some cases of injury to the eyes from the tremendous flash of lightning or an electrical short circuit, in which cases there is good reason to believe the action to be very complex. the quartz arc seems to be the sole source of injury from extreme ultraviolet radiation. As such arcs are in very limited use at present and can be readily guarded against, the practical danger chargeable to the ultraviolet seems very slight indeed. It probably requires a considerable integral of ultraviolet energy concentrated on the eye to do harm, since in some of the recorded cases the victim had worked for many hours alongside an Arons lamp before experiencing any trouble. If the danger came in any material degree from any but the very short wave-lengths, we should be in continual trouble from sunlight, which is far richer in the ultraviolet than ordinary artificial illuminants.

In short, looking over all the evidence, it appears that there has been a rather needless scare over ultraviolet rays. That a particular class of them, very weak in all ordinary illuminants and easily stopped, does produce a peculiar and easily recognized type of injury to the eye is beyond dispute; but from a practical standpoint there is immensely greater danger from too great concentration of energy in the form of ordinary light. Indeed, if one follows the ordinary matter-of-fact rule of screening all sources of high intrinsic brilliancy to avoid glare, there is nothing to be feared from the ultraviolet. Professor Gariel, indeed, classifies the commercial illuminants in the following order as regards proportion of ultraviolet rays: Oil lamps, petrol lamps, electric incandescents, Welsbachs, acetylene, mercury arcs, ordinary arcs. He finds that the ultraviolet is practically cut off by medium shades of yellow glass used as shades or spectacles, and advises the free use of the former in shading very brilliant lights. As regards the general requirements for illumination, Professor Gariel is quite in accord with the trend of present practice. He advises an illumination of at least 15 lux as a minimum for good lighting, and strongly advises the effective diffusion of the light from intense sources. He strongly favors the electric incandescent as the basis of interior lighting, and incidentally gives an example of the psychology of illumination with which we may appropriately close this notice. It seems that the Paris Opera House changed from gas to incandescent in 1889, and the change had been widely advertised to take place on a certain evening. Next day appeared a patient, otherwise intelligent, who complained of troubles of vision and severe headache, following his attendance at the first performance given by this devilish electric light. A couple of hours later Dr. Gariel ascertained that, owing to an accident to the machinery, the opera on that evening had been lighted by gas, as usual. We have a strong feeling that when this is conscientiously done, cases of injury from artificial light will generally turn out to be due far more to the improper use of the source than to any peculiar quality inherent in it. Keep lights steady, and screened to a reasonably low intrinsic brilliancy, and there will be few complaints.

The Reunion Amicale of the International Electrotechnical Commission at Brussels.

The last meeting of the International Electrotechnical Commission was held at London in October, 1908. The next meeting is scheduled to be held in 1911. It was decided, however, to hold an unofficial meeting or "réunion amicale" this summer, in preparation for next year's meeting, and the Belgian committee offered a cordial invitation to all the national committees that they should hold the reunion at Brussels Aug. 8 to 11. The Brussels Exposition being open this summer offered additional attractions to the plan, which was entered into very heartily.

The following national committees were represented at the reunion:

Austria.—Herr Seidener.
Denmark.—Prof. A. Larsen.
France.—Mm. A. Armagnat, P. Boucherot, E. Brunswick, J. Blondin and Ch. David.
Germany.—Dr. E. Budde.
Great Britain.—Major W. A. J. O'Meara, Messrs. W. Duddell, K. Edgcumbe, R. Hammond, W. H. Patchell and P. F. Rowell, secretary of the Institution of Electrical Engineers.
Holland.—Mm. C. H. Julius and W. B. Smit.
Italy.—Mm. C. Clerici, G. Semenza and S. Verole.
Japan.—Prof. H. Nagaoka.
Switzerland.—M. Täuber.
United States.—Dr. A. E. Kennelly and Mr. C. F. Scott.

The Belgian committee, acting as hosts, were represented by the following delegates: Mm. Prof. Eric Gerard, Armand Halleux, Léon Gérard, G. A. L'Hoest, Omer De Bast, Albert Hanssens, Louis Mettewie, A. Briffaux, Emile Closset, Gustave Coune, M. Creplet, Ernest D'Hoop, Vital Françoise, E. Gevaert, G. Gillon, Robert Goldschmidt, Saturnin Hanappe, Albert Jaspar, Edouard Lacomblé, Paul Nemery, Emile Piérard, F. Saurat, Fernand Vande Wiel and Emile Vytborck. The total attendance was thus 47 representatives, including 23 from countries outside of Belgium. The honorary secretary of the commission, Col. R. E. Crompton, C.B., and the general secretary, Mr. C. Le Maistre, were also in attendance. The president of the commission, Prof. Elihu Thomson, was unable to leave the United States to attend the reunion, but forwarded a message of encouragement and goodwill.

The program issued by the Belgian committee comprised three days of business sessions (Aug. 8 to 10), and three days of visits to plants, factories and places of electrotechnical interest (Aug. 11 to 13).

The general secretary, Mr. Le Maistre, issued in advance of the reunion a program of the business to come before the meeting. It comprised three general topics, namely, (1) nomenclature, (2) symbols, (3) rating of machinery.

The opening meeting was called to order on the morning of Aug. 8. Prof. Eric Gerard was unanimously elected chairman of the sessions. Professor Gerard read an address of welcome. Col. Crompton, the honorary secretary, read a brief report outlining the history and progress of the commission, showing that 16 countries were now officially taking part in the work.

The first subject under discussion was that of nomenclature. It was shown that lists of electrotechnical definitions in alphabetical order had been completed by the British committee from A to E, and by the French committee from A to G. These two lists were in process of being mutually adjusted into conformity. The Italian committee had also made progress.

Dr. Budde offered the opinion that the lists of terms and definitions under preparation by the above mentioned committees were too lengthy and time-consuming. He submitted a list of 80 German terms, with their corresponding terms in English and French. All of these terms related to dynamo-electric machinery. He proposed that this list of equivalent terms should be made the basis of further and more accelerated progress in nomenclature, leaving the work already undertaken by the other committees to be completed at leisure. Dr. Budde's proposal was discussed at length by Messrs. Boucherot, Hammond, Duddell, Siemens, Semenza, Brunswick, and others. It was then deferred for reconsideration at the next session.

The next subject considered was that of symbols for use in electrical engineering, a suggested list of which had been previously prepared and submitted by the United States committee. The French committee proposed a series of regulations of principles, for provisional adoption, on the types and styles of letters which should be used in electrotechnical formulas. This proposal was also deferred to the next session for further consideration, and the meeting then adjourned.

At the second meeting, on the morning of Aug. 9, the subject of nomenclature was again considered. After a long discussion, participated in by representatives of a number of countries, it was unanimously voted as the sense of the meeting that Dr. Budde's list of equivalent terms should be adopted as the basis of further work in definitions by the various national committees; but that the French committee, with the aid of the Belgian committee, should prepare a separate systematic and logically connected system of definitions for subsequent consideration; also that a subcommittee of three from the British, French and German committees should meet between March 1 and Sept. 1, 1911, to collate the various nationally prepared lists for report to the next meeting of the commission.

The attention of the commission was drawn to the fact that next year (1911) joint expositions are scheduled to be held at Turin and at Rome. Preliminary proposals had been made to hold an electrical congress at Turin in connection with the exposition. It was suggested that if it were possible to hold the meeting of the commission at Turin this would probably be of great service to all concerned.

Dr. Budde, on behalf of the German committee, expressed his belief that although his committee would, of course, prefer to have the commission meet next year in Berlin, yet, in view of the undesirability of attempting to convoke the commission in one city and an electrical congress of very largely the same membership in another city, during the same season, he felt sure that it would be better to choose Turin as the place of meeting in case an electrical congress was to be held there. It was then voted to leave the decision as to the place of meeting next year to the Italian committee in conference with the German committee.

The question of symbols was next discussed at considerable length by a number of delegates. It appeared as though the matter was likely to be returned back to committee, until a solution presented itself and it was unanimously voted to adopt as the sense of the meeting five of the French committee's recommendations, and also the list of nine symbols proposed by the American committee, with certain slight amendments, and with the single exception of the symbol for permeability, owing to some question as to the use of Greek letters.

The question of rotation of vectors was next considered. It was reported by the American delegates that at the last convention of the American Institute of Electrical Engineers (at Jefferson, N. H., in June-July, 1910) a resolution had been carried to submit the question to the commission for an international decision as to which direction of vector rotation should be adopted in electrotechnical literature. It was recommended that the matter should be taken up for consideration, and that the various national committees should be invited to submit arguments on either side of this question for circulation by the central office, with a view to a decision being reached at the next meeting of the commission. The meeting then adjourned.

The third and last day's session was devoted almost entirely to the discussion of the United States committee's proposal on the subject of rating of machinery. The matter was debated at considerable length by Messrs. Crompton, Budde, Boucherot, Hammond, Kennelly, Scott, Semenza, Hanssens, Siemens, de Bast, Brunswick, Hanappe, Duddell, Julius and Larsen. A unanimous resolution was finally arrived as to the effect that in the case of direct-current machines the output of generators should be defined as their electrical power available at terminals,

and the output of motors as the available mechanical power at their shafts. In both cases the power should be expressed in international watts. This resolution definitely deals with Clause A of the United States committee's proposal. It was decided not to take up Clause B at the present time.

At the suggestion of Dr. Kennelly a resolution was unanimously reached, on a motion by Signor Semenza, that if names should be needed in the future for other electromagnetic units the name of Kelvin should be given first consideration.

After unanimous votes of thanks to Chairman Gerard, Honorary Secretary Col. Crompton and General Secretary Le Maistre the session adjourned.

Following is the list of symbols and synopsis of their rules recommended to the several national committees for international adoption:

Electromotive force	E, e
Electric quantity	Q, q
Inductance	$\mathfrak{L}$
Magnetic force	$\mathfrak{H}$
Magnetic flux-density	$\mathfrak{B}$
Length	L, l
Mass	M, m
Time	T, t

Small letters are to be reserved for instantaneous values of electrical quantities varying with time, and capitals used for effective or constant electrical quantities.

Capital letters with subscript m to be reserved for maximum cyclic values of periodic electrical quantities, capital script letters for magnetic quantities, and with the subscript m for the maximum cyclic values of periodically varying magnetic quantities.

Eastern Tennessee Hydroelectric Plant.

Work will soon be commenced on the dam and hydroelectric power station of the Eastern Tennessee Power Company, on the Ocoee River, at Parksville, Polk County, Tenn., about 12 miles from Cleveland, Tenn.

The dam will be of cyclopean concrete and about 780 ft. long on the crest. Four hundred and thirty lineal feet of this dam will be of the overflow type and 350 lineal ft. will be of the non-overflow type. The overflow portion, which will be about 110 ft. high above mean water stage, will be of the usual ogee section. The non-overflow portion of the dam will be about 13 ft. higher than the overflow section and will be of a special section to accommodate penstock intakes at the top and penstocks passing from the intakes to the turbine below.

The power house will be located on the down-stream side of the non-overflow portion of the dam and will be an integral part of the same. The substructure will be of massive concrete and will consist mainly of piers and arches below the dam. The turbines will be located at the elevation of the main floor and will discharge into the tailrace under the arches. The superstructure will consist of brick or stone walls with enclosed steel columns. These columns will support the superstructure floors, crane runway and steel-roof trusses. The superstructure floors will be reinforced concrete slabs supported on steel girders and floor beams. The roof slabs will be reinforced concrete supported on steel purlins and will be provided with suitable roof covering.

The power equipment will consist of four main units of normal rated capacity of 3000 kw each, one 200-kw exciter unit, the necessary step-up transformers and switching equipment for the control of this apparatus. Each main unit will consist of one tandem horizontal turbine in enclosed case direct-connected to a three-phase, 60-cycle, water-wheel type alternating-current generator. Each generator will have mounted on its shaft an exciter having a capacity sufficient for its excitation.

The miscellaneous equipment will consist of an electrically driven traveling crane; a transformer truck; necessary gates and gate hoists; water, oil and air circulating systems; miscellaneous piping; pumping apparatus, lighting system and all other apparatus which is essential for the complete equipment of a first-class station.

A tailrace will be excavated for some distance down-stream from the power house and will, if found necessary, be separated from the main river channel by timber crib or concrete wall. The shore of the river adjacent to the power house will, if necessary, be protected by means of a riprap. A permanent gravel or macadam road will be constructed from the present highway to the power-house entrance. Along the Ocoee River and its tributaries public roads will be relocated at various places where their present grade is below the maximum flow line of the reservoir. New bridges, culverts, etc., will be built where necessary, due to these changes.

The estimated cost of the work is approximately $2,000,000. The contract for the complete engineering and construction of the plant has been awarded to J. G. White & Company.

Widespread Combination of Public-Utility Properties in Minnesota and Adjoining States.

An important combination of public-utility companies in the states of Minnesota, North Dakota and Wisconsin, but centering at present more particularly in the southern part of Minnesota, has been made by the recently organized Northern States Power Company. This company is a holding company owning the controlling interests in the stock of the Consumers' Power Company and the Apple River Power Company. The Consumers' Power Company controls the plants in Minnesota and North Dakota and the Apple River Power Company the two water-power developments in Wisconsin, near Stillwater, Minn., which comprise all the present properties in Wisconsin controlled by the Northern States Power Company. H. M. Byllesby & Company, of Chicago, are promoters, engineers and operators for the Northern States Power Company.

In St. Paul, Minn., the largest city in the territory involved, the combination has acquired the Northern Heating & Electric Company, which is a comparatively new central-station company doing an electric-service and district-heating business. The general manager of this company since Jan. 1, 1910, has been Mr. H. C. Eddy, who has made a conspicuous success in directing its affairs. The Washington County Light & Power Company, of Stillwater and White Bear, Minn., has been acquired by the Consumers' Company. In Stillwater it has supplied gas and electric service, and in White Bear it has been a straight electric utility. At Hudson, Minn., near Stillwater, a gas company has been acquired. Stillwater and White Bear are not far from the two water-power developments on the Wisconsin side of the St. Croix River, and belonging to the Apple River Power Company. They are supplied with electricity from these hydroelectric plants.

South of St. Paul, at Cannon Falls, on the Cannon River, near Northfield, Minn., there are two water-power developments now under construction. There is a head of 55 ft. in the river at this point and about 2000 hp will be developed. At Northfield, the Northfield Light, Heat & Power Company, an electric company, has been acquired for the system, while the local Cannon Falls Electric Service Company is also a part of the system. There is a transmission line from this point to Faribault, where the Faribault Gas & Electric Company is the local property belonging to the system. From Faribault west to Mankato, a distance of about 45 miles, it is proposed to build an additional transmission line. At Mankato, the Mankato Gas & Electric Company has been acquired, and 8 miles south of this city a water-power development with a 60-ft. head is being built on the Blue Earth River. About 2000 hp will be available from this hydroelectric station. A feature of the Ambursen dam which will be built here will be that the county bridge over the river at this point will form a part of the crest of the dam.

In the northwestern part of Minnesota and in two adjacent cities in North Dakota, just west of the Red River of the North, which forms the boundary between the two states, is another group of properties belonging to the Consumers' Power Company, and in turn controlled by the Northern States Power

Company. At Grand Forks, N. D., the Grand Forks Gas & Electric Company has been acquired. This company supplies the gas, electric service and district heating. Across the river is East Grand Forks, Minn., and here there is a gas and electric property which is included in the system. About 45 miles east of these cities is Red Lake Falls, Minn., where the Red Lake Falls Electric Company has been acquired. Near by is a water-power development on the Red Lake River, and it is proposed to connect Red Lake Falls and Grand Forks by a transmission line. Ninety miles south of Grand Forks is Fargo, N. D., and here the Union Light, Heat & Power Company has been acquired. This company supplies gas, electric and heating service. Across the river a gas plant has been acquired in Moorhead, Minn.

All the companies and properties mentioned will be operated as one concern. There is a rapid extension of the business of supplying gas, electricity and heating in the territory named. The gas business is pushed in the direction of using it as fuel, particularly for domestic purposes. The companies controlled by the Northern States Power Company have made a feature of giving away gas stoves to consumers if the latter will agree to burn a certain amount of gas. In this way about 3000 gas stoves have been placed throughout the system in one month.

Chicago Consolidated Traction Company Rehabilitation.

There now appears to be a good prospect of the merger of the Chicago Consolidated Traction Company with the Chicago Railways Company and the rehabilitation of the street-railway surface lines of the former in the outlying portions of the North Side and West Side of Chicago. Negotiations looking toward this end have been protracted, owing to difficulty in arriving at a settlement with the owners of the underlying bonds of the Consolidated properties. On Aug. 15, however, the reorganization committee of the bondholders accepted the final valuation of the tangible property of the Consolidated Company (including legal expenses, brokerage, etc.) made by Messrs. Bion J. Arnold and George Weston, engineers acting on behalf of the city of Chicago, which was an active party to the negotiations, as the franchises of the Consolidated lines have in many cases expired or have nearly expired. This valuation was $3,957,454, and it believed that the sum inserted in the rehabilitation ordinance, which will be presented soon at a meeting of the City Council, will be a round $4,000,000. If the ordinance is adopted, it is said that 29 miles of the tracks of the Chicago Consolidated Traction Company will be rehabilitated before next spring, and that 215 of the large pay-as-you-enter cars will be added to the equipment. As far as local conditions permit, the rehabilitation ordinance will follow the same lines as those adopted in the case of the Chicago City Railway Company, the Chicago Railways Company and the outlying companies on the South Side.

By the terms of the agreement, the Chicago Railways Company will acquire the plant of the Consolidated Company, free from liens or incumbrances of any sort, placing the physical properties on its books at the valuation of $4,000,000 mentioned. This company is to agree to commence rehabilitation immediately upon the passage of the ordinance, and to finish the work within 18 months. In the detailed statement of the valuation, the principal item is for track, which is valued at $1,121,216. The value of the electric power distribution is placed at $695,416; power plant, $410,463; rolling stock, $195,119; while the items of real estate, buildings, tools, supplies and furniture, paving, brokerage, construction profit, legal expenses, etc., make up the remainder.

The Chicago Railways Company is in the hands of receivers owing to the entanglements growing out of its relations with the Chicago Consolidated Traction Company, but it is believed that in case the present agreement is carried into effect, the receivers will be dismissed. However, the receivers of the company are given the right to take over the Consolidated properties in case they are not dismissed before the date of the passage and acceptance of the ordinance. One provision of the agreement is that in case the present arrangement fails to be accomplished, owing to some unexpected legal difficulty, the Chicago Railways Company shall extend its lines over the streets now occupied by the Consolidated Company as fast as existing franchises expire. This provision was inserted to protect the city in case the plan for reorganization should prove unsuccessful.

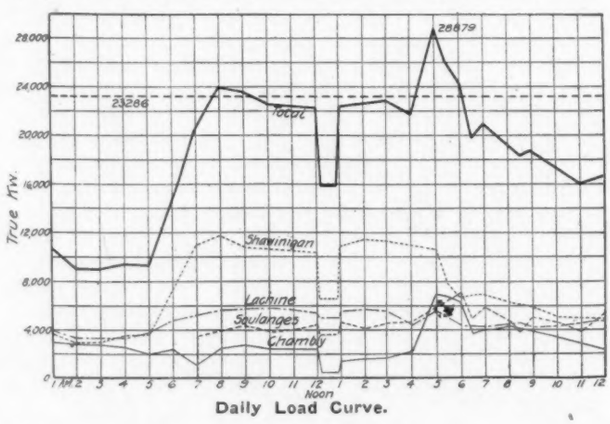
Since the above was written a new complication has arisen in a suit begun by three holders of Consolidated Traction general mortgage bonds against the Chicago Railways Company. The plaintiffs seek to recover the value of $125,000 worth of bonds, with two years' interest, making $139,000. Counsel for the receivers of the two companies and for the city seem to agree, however, in the belief that the new suit will not be a dangerous menace to the rehabilitation plans.

Montreal Lighting Controversy.

Pursuant to adjournment from the previous week, the arbitrators hearing the matter between the Montreal Light, Heat & Power Company and the city met on Aug. 16 in Montreal, having arranged for a four days' hearing.

Mr. Butler, the city's attorney, examined Mr. R. M. Wilson, the city engineer, with regard to the statements of costs of maintaining the city arc service, previously submitted. The company, being requested to produce vouchers for one year, brought into court between 300 and 400 boxes containing thousands of vouchers, together with books and records of the company's accountants, which presented so formidable an array as apparently to deter Mr. Butler from attempting a detailed examination of the same.

Considerable time is being lost at the hearings through the raising of legal questions, and the making of objections of various kinds by the several attorneys interested in the case, so that the getting of the real information required by the arbitrators on the records is a slow and tedious matter. An interesting fact brought out shows that the Montreal company maintains four reserve steam plants, which in winter are prepared to take up promptly the load in case of failure of any or all of the four sources of supply from hydroelectric plants. These steam stations, with their capacity, are as follows: Queen Street station, 3300 kw; East End station, 1020 kw; Chenneville Street station, 900 kw; Cote St. Paul station, 450 kw; total, 5670 kw. Testimony was given as to the flexibility of the company's system in permitting it to transfer its load, and particularly the city arc lighting, from one source of power to another, thus ensuring uninterrupted service. It developed that in addition to 1666 alternating-current, 6.6-amp enclosed lamps supplied the city of Montreal, 196 additional lamps of the same character are furnished adjacent municipalities, together with 250 9.6-amp direct-current open arc lamps. Mr. Wilson testified that his lamp trimmers recarbon 502 enclosed-arc lamps per day. Before the expiration of the last contract with the city, which ran for five years beginning Jan. 1, 1904, but a comparatively



Daily Load Curve.

small amount of the company's income was derived from city lighting; for example, the figure for the fiscal year ending April 30, 1907, showed only $98,272 out of a total revenue of $2,037,873—that is about 4.8 per cent; and for the year ending in 1908 the arc income was $101,895 out of $2,251,186, or 4.5 per cent.

The defendant's attorney called for records and curves showing the maximum demand for power on all the stations combined for various years. One of these exhibits is reproduced herewith. The loads supplied by the various water-power plants are shown separately, and also summarized. The peak load reached the maximum of 28,879 kw on Dec. 1. The averages of the maximum loads throughout the year are indicated by the light line at 23,286 kw. The testimony indicated that the curve given was typical of the daily load. The relatively small peak and the large and uniform day load are obtained by the sale of limited power to large customers, such as mills, which close down early in the afternoon before the lighting peak comes on, thus giving an unusually high load factor, seldom below 65 per cent and frequently reaching from 80 per cent to 85 per cent.

Legal Regulation of the Consulting Engineer.

BY SYDNEY W. ASHE.

England boasts of her code of law procedure. Still attention is called by Mr. W. Valentine Ball*, in a recently issued volume, to the fact that she possesses no laws regulating the ways of the consulting engineer. This fact is all the more interesting because practically the same conditions exist in this country. "Whatever the code of professional ethics may prescribe," he says, "the statute book lays down no rules to guide engineers or their clients. Touting and advertising offend against no act of Parliament; and it is in this respect that, for good or ill, there is a great difference between the brotherhood of engineers and other learned professions. The General Medical Council, for example, exercises certain disciplinary powers over registered medical practitioners. If a doctor is guilty of infamous conduct in a professional respect he may be deprived of the right to practise. It has been held, moreover, that the powers of this council are not limited to matters which would be dealt with in the law courts. Thus a doctor who advertises can be struck off the register.

"Again, the State exercises control over those who practise dentistry. A man who improperly assumes the title of dentist may be struck off the register, while it has lately been decided that anyone who adopts a title which is calculated to lead the public to believe that he is qualified as a dentist in the popular sense may be prosecuted and fined. In the profession of the law the Incorporated Law Society can deal with solicitors, while the benchers of the Inns of Court have power to supervise the action of every member of the bar. But the engineering profession has no domestic body to control and prescribe rules of conduct for its members."

The means which have been applied in this country to solve this problem have been to attempt to regulate who should use the title consulting engineer and then to rely upon the professional standing of the individual to protect his clients. The public at large is very quick to condemn engineers who make mistakes either directly or indirectly. A doctor may improperly prescribe, the patient die and no one be a whit the wiser; but the financial interests in this country are so alert to the competency of engineers that should improper advice be given the engineer would quickly lose his standing. Some years ago the American Institute of Electrical Engineers as a result of the presidential address of Dr. S. S. Wheeler formulated a code of ethics in which the use of the title of consulting engineer was regulated, but for some unexplained reason this was never brought before the membership for final adoption or rejection. The English Institution of Civil Engineers has gone a step further, its committee in 1902 having recommended the following rules of professional etiquette for its members:

"1. No consulting engineer should solicit employment as consulting engineer verbally, by letter, by agent paid by commission or otherwise, or by any other means.

"2. No consulting engineer should answer advertisements for consulting engineers.

"3. No consulting engineer should advertise for employment.

"4. No consulting engineer should pay by commission or otherwise any one who introduces clients.

"5. No consulting engineer should receive trade or other discount, or surreptitious commissions or allowances in connection with any works which he superintends.

"6. A consulting engineer who is also directly or indirectly interested in any contracting or manufacturing business should inform his client in writing what his connection is with such contractor."

The general idea in the whole scheme of engineering ethics seems to be that only those who have had a wide variety of experience, theoretical and practical, extending over a number of years are entitled to call themselves consulting engineers. It appears unnecessary to have rules or laws regulating the professional behavior of such men, as their professional standing, as previously mentioned, should be a sufficient regulator. The ordinary physician, although of long standing, is likely to meet competition from the newly graduated M.D., and it is, therefore, wise to have rules regulating the behavior of the recent graduate; but the consulting engineer has nothing to fear in the way of competition from the newly graduated electrical engineer, and if means are taken to regulate when the latter can assume the title of consulting electrical engineer this would appear to be the only regulation necessary. While it is true that this would impose a heavy burden upon the young, ambitious, capable engineer whose career lies before him, still it would strengthen the engineering profession to instill in its members some of the code of honor that exists in France.

Associations of Consulting Engineers.

Germany has had an Association of Electrical Consulting Engineers since 1902, the name of the body being the Verein Beratender Ingenieure für Elektrotechnik, with headquarters at Berlin. The requirements for membership are very strict, including scientific education, extensive practical experience and absolute commercial independence. The president of the society is Dr. E. Mullendorff.

As recently noted in these columns, an Association of Consulting Engineers has been formed in England, and will be finally organized after the summer vacations. The honorary secretary is Mr. Alfred H. Dykes.

One of the principal objects of the British association is to assure that municipal and other public works shall be supervised by duly qualified consulting engineers. In order that this may be done, it is necessary to know who is a qualified consulting engineer, and it is hoped that the register of the association will give this information.

The association will not be antagonistic to the principle of specialization, as the intention is to include in the association all branches of the profession—civil, mechanical, electrical, gas, and possibly others. It is not suggested that every member should possess a knowledge of all branches, or even more than one. Every member will be as free to specialize as he is now. All that is proposed is that every member shall be a properly trained and qualified engineer, and that he shall be acting solely in a professional capacity—that is, as a consulting engineer.

It is not intended to encroach in any way on the authority of the councils of the leading institutions which deal with the different branches of engineering. In fact, it is hoped that these councils will support the association as acting in the interests of those of their members who are consultants. Although the existing institutions are thoroughly representative of the profession of engineering as a whole, their province has been to deal with the science and problems of engineering which are of equal interest to all engineers. The association does not propose to deal with these matters at all, but only with the

*The Law Affecting Engineers (Mr. Ball has been a frequent contributor to these columns). W. Valentine Ball, M. A. (Cantab.). London; Archibald Constable & Company.

professional status and conduct of those engineers who have adopted consulting work as their profession, and who represent a comparatively small percentage of the engineering body as a whole.

The by-laws governing professional conduct issued by the Institution of Civil Engineers, and now adopted also by the Institution of Electrical Engineers require that the members of these institutions when acting in a "professional capacity"—that is, as consulting engineers—shall conform to certain rules. The above institutions can make no distinction between their members, and are therefore not able to say to which of their members the rules are applicable. As the rules stand, a member can act in one capacity one day and in another the next. The organizers of the new association believe there is, or should be, as clear a distinction between the work of a consulting engineer and that of other members of the engineering profession as there is between the work of a barrister and that of a solicitor in the legal profession, and the association has been formed to clearly define this distinction.

The register of the association will, it is hoped, form a complete list of the qualified consulting engineers to whom the professional conduct rules above referred to will be applicable at all times, and which register will be open to inspection by the authorities responsible for spending public money, as well as to anyone else requiring the advice of a consulting engineer. The rules of the association, which are now under consideration, and will be submitted to a general meeting in the autumn, will be based on the professional conduct rules of the Institutions of Civil and of Electrical Engineers, to which it is intended to add other rules applicable to consulting engineers only.

At present membership is confined to those who are corporate members of the Institution of Civil Engineers and also of the institution representing the particular branch of the profession in which they practice. The Institution of Civil Engineers has taken the lead in establishing examinations for admission, and has in many other ways taken great pains to improve the status of the engineering profession. The association is not prepared at the present time to accept the responsibility of considering the qualifications of engineers other than those mentioned above, but it will no doubt be able to do so in the future should it receive the support it desires from all members of the profession. A provisional list of members is now being drawn up which will be revised after the constitution and rules of the association have been settled.

Indiana Electric Light Association Convention.

The second annual meeting of the Indiana Electric Light Association was held at the Denison Hotel, Indianapolis, Aug. 17 and 18, 1910. The attendance was large, the registration reaching 102.

In calling the meeting to order President C. C. Perry, of Indianapolis, announced the appointment of Mr. J. V. Zartman, of Indianapolis, as secretary following the death of the former secretary, Mr. Fred M. Leslie, of Muncie. Secretary Zartman reported the financial condition of the association to be good, and announced a total active membership of 99—a gain of 27 during the year.

In his annual address President Perry referred to the good work of the secretary already in bringing about the growth shown the past year, and remarked the constant and energetic work required on the part of the officials to impress upon the companies of the state the importance, benefit and desirability of membership in an organization which is of mutual aid to all. He said he regretted the indifference and the willingness of some electrical men to allow the more progressive companies to carry their burden while they derive the benefits without being members. He also observed that the Indiana Association is now—and can be made even more so—one of the most helpful and efficient organizations in the development of the electric service business in the country. President Perry spoke of the progress that has been made along a great many lines and of the better understanding existing regarding the wants of the people. He called attention to the general and varied use of electric devices outside of the motor-service and lighting fields that have made it possible for central-station plants to get better load-factors. The sale of these devices at practically cost to the consumer by the station companies, he said, has been criticised and opposed by the supply men, and he remarked that this matter was one for the convention to discuss and justify. Mr. Perry also questioned the advisability of lending the association's aid and influence toward the formulation and enactment of a public-utility commission which will doubtless come before the next Indiana Legislature.

Mr. Charles A. Bookwalter, former Mayor of Indianapolis, and now associated with the Merchants' Heat & Light Company, of that city, also addressed the convention on the subject of the impending public utility law, which, he insisted, may be confidently expected during the next Legislature. Mr. Bookwalter said he did not believe such a commission would hurt the electric-light business, but would be rather a benefit to both the companies and the consumers. He thought it would discourage the duplication of plants in territory not sufficient to support them. He said he did not look upon the possibility of a utilities commission as a serious matter, providing the appointing power selected men who are competent and fair to look after the matters under their jurisdiction. "The Indiana Railroad Commission has made good, and no one wants it abolished," said he. Mr. Bookwalter deplored the fad of American municipalities to grant short-time franchises, or miscellaneous franchises to promoters. This is not fair to investment of capital in public service plants, and would be remedied under a commission. Nor can there be objection, he thought, to a commission control to prevent abuses that are inimical to the people.

The discussion of a public utilities commission and its probable affect in Indiana was ably continued in a paper by Mr. T. C. McReynolds, general manager of the Kokomo, Marion & Western Traction Company. The centralization of the supervision of public utility properties, said Mr. McReynolds, is in line with modern economical thought, and in theory is right. A commission composed of intelligent men, who are constantly in touch with utility properties, is much more able to judge as to the equitable relation which should exist between such utility properties and the public than would be local councils or boards of public works.

The question of granting the proper franchises and establishing equitable rates for the service rendered cannot be handled with that degree of skill and intelligence by local authorities as through the medium of a commission, whose members are trained by daily experience for such purposes, and who are free from all environments of local politics and prejudices.

The commission, he declared, would not only act as a medium through which adjustments would be made between the public and utility properties, but would aid materially along educational lines to all concerned, and especially the small utility companies. Many small electric-light companies are operating in Indiana on a losing basis, rendering poor service, and have practically no hope or encouragement held out for bettering their condition. In such instances, if the same practice was invoked as in other states, the commission when called upon would make an investigation of local conditions and ascertain the trouble. If improvements were necessary, these would be ordered, and rates would be adjusted so as to enable such companies to procure the necessary capital to make improvements and earn a reasonable profit upon their investment. The cloak of protection of the state would be thrown around such a company—eliminating the fear of competition by some rival promoter, placing what was once a losing investment on a profitable and permanent basis, furnishing sufficient and good service, and winning the confidence and respect of the whole community.

Mr. McReynolds said he thought there could be no legitimate objection to the enactment of a conservative law which has for its purpose better regulation in connection with issuing stocks and bonds. He is not, he said, in favor of any legislation that would have a tendency to frighten away capital, or serve as a menace to capital already invested, or would prevent or curb the reaping of reasonable rewards from such investments, but

he would approve of the enactment of such legislation as will prevent the organization of corporations and the issuing of stock and securities without regard to the intrinsic value represented, and the sale of such securities to people who have not the opportunity or inclination to make such investigations as would reveal the true condition of their value.

Mr. E. M. Poor, of Sullivan, said he thought the association should go on record as favoring a public utilities commission. He cited instances of illegitimate competition which would be prohibited by such a commission.

Mr. F. A. Bryan, of the Indiana & Michigan Electric Company, of South Bend, said the subject appealed to him as being the most important of the convention. He urged the necessity of the association's taking steps toward securing the services of good legal talent in formulating the kind of law that would prove satisfactory. He said such laws tried out in certain other states are bringing about good results.

During the discussion several raised the question of the cause of the failure of the passage of the bill two years ago. It was thought by some that the apparent willingness of the public-service corporations to the enactment of such a law occasioned the local press and a few legislators to oppose its passage, suspicion being created by the activity of the public-service corporations in favor of the bill.

The afternoon session was opened by the reading of a paper on the "Commercial Value of Low-Head Water-Power," by Mr. F. A. Bryan, general manager of the Indiana & Michigan Electric Company, South Bend. Mr. Bryan presented a practical account of the limitations of water-power development, and exhibited a number of tables showing under what conditions a steam plant or a hydroelectric plant might be expected to be most profitable. An abstract of this paper will be given in a later issue. The discussion of Mr. Bryan's paper was led by Prof. C. F. Harding, of Purdue University, who cited some interesting cases within his own experience.

The next paper was read by Professor Harding, head of the electrical engineering department of Purdue, on "The Relation of Purdue University to the Electric Public-Service Companies of Indiana." The speaker urged co-operation between practical operators and the instructional corps, enlisting the aid of each to complete the effectiveness of the work of the other in training students. He suggested that greater use be made of the facilities for carrying out tests which the university is able to present to electric companies of the state, with its splendid instrument and laboratory equipment. While the employment of students on such tests is necessarily secondary to regular instruction, it is nevertheless encouraged. Besides researches and examinations in both practical electricity and pure science, the university renders valuable service in answering technical queries and in serving as a clearing house for practical information.

Professor Harding's paper was well received. President Perry remarked, "The talented men of Purdue have always shown a commendable and generous spirit in rendering valuable assistance to electric associations of the state. The students turned out by Purdue are all right. Those we have employed have made good," said he.

The concluding paper for the day was presented by the engineering department of the National Electric Lamp Association on "The Cost of Light." This discussion was a study of the various cost factors entering into the charge for electric service from the central station. It recognized a demand charge, a customer charge and an output charge, the second being based on the first with a proper reference to the diversity factor of the service, and the last named, or output charge, being figured on the energy actually delivered rather than that generated, and so not including the losses. Reference was also made to the use of current-limiting devices for small flat-rate customers. Tendency to waste energy by long-hour burning could be prevented by having customers purchase their own renewals and impressing them with an understanding of how extravagant burning will shorten the periods of renewal.

Mr. A. C. Blum, of Evansville, and Mr. Perry, of Indianapolis, discussed the paper briefly. Mr. Perry said that the questions brought out should not be dealt with on any other than a scientific basis. The fixed charges and the rate to consumers are important factors, and while the purpose of a plant is to serve the people, in order to do this it is absolutely necessary to get a revenue.

The morning session of the second day's convention opened with a discussion of the relation of central stations to supply houses, relating especially to some aspects of the sale of electrical apparatus to customers by central stations at practically cost, or at figures below those possible for the supply houses to meet.

Mr. C. A. Howe, of Chicago, representing the supply men, said that the supply men deplored the lack of co-operation between station men and the dealers. He said that the practice of electric companies in selling devices at cost, while unfair to the regular dealers, was not even appreciated by the consumers, who are not disposed to credit the company with disposing of anything without a good price. For this reason a fair margin might as well be secured, he thought, by selling at not less than the list price. He deemed the matter important and hoped a better and more equitable understanding might be brought about.

Mr. G. M. Sanborn, of Indianapolis, who is president of the National Electrical Contractors' Association, remarked that having been a contractor for years, it was difficult to get used to the competition of the central-station companies. "If present practices are kept up supply houses, in some places at least, will be put out of business and central-station men must prepare to control the business in its entirety." He admitted that new business must be developed by introducing appliances, but thought it far better to do so by co-operating with the contractors, who, he said, are the electric company's best solicitors. The best way to solve the question, he concluded, is to get together, the central-station men taking the initiative and affording the strength of their capital.

The subject was further discussed by Messrs. McReynolds, Perry, J. W. Robb, of Clinton; T. C. Pullen, of Evansville; T. F. English, of Muncie, C. B. Hart, of Fort Wayne; George Loring, of Indianapolis, and others, each giving his experience in handling lamps and devices. The central-station men seemed to make a pretty strong case of being compelled to handle these sales in order to do the soliciting and demonstrating and otherwise to bring the use of the electric devices to the attention of the people, testifying in some cases that contractors are too slow and indifferent to push the development of new business. Mr. McReynolds made the point that he believed established commercial appliances should be left for the dealer to handle, while new devices needing popular introduction are best disposed of through the central-station office, even if at cost price. One manager present said he was now forced, against his will, to do all the wiring in his city, because the combination plumber-electricians, who are the only contractors, proved so incompetent and irresponsible. These men would give no assurance of good installation, held up jobs indefinitely, and in the end the central station had to make good these mistakes. Most of the speakers agreed that the sale of lamps must be handled by the station to secure a good grade and satisfactory service. Mr. Loring pointed out that where contractors and supply men fail the local central station must be all things. However, he believed that dealers prefer to handle a better grade of lamp than they are now able to dispose of, being prevented from receiving a fair price in competition with the low renewal rates of electric companies. The new tungsten lamps have been taken over by central stations in an effort to control the wattage of these lamps on their lines, for it should be remembered that for each dollar of first cost of an energy-consuming device the central station derives returns of $2 or $3 a year.

Following this discussion an interesting talk was given on "New Developments in Heating Devices," by Mr. W. F. Hadaway, of the Westinghouse Electric & Manufacturing Company. Mr. Hadaway discussed the general principles of heating apparatus construction, and described the new "stove-lid" enclosed

unit which marks the most recent advance in an art more than 20 years old—for a full set of electric cooking appliances was exhibited at the World's Fair in Chicago in 1893. Improvements since then have been chiefly in the resistors employed, the various nickel alloys now used being capable of high temperatures and rapid changes. The so-called stove-lid unit is built up of a pair of iron plates pressed together on the resistor and welded along their periphery by an oxy-acetylene torch. Electric cooking apparatus suffers the serious competition of gas and coal, for while electric stoves can be worked to a heat conversion density of 12 watts to 15 watts per square inch, fuel stoves can be similarly worked to a density equivalent to 35 watts to 40 watts per square inch. Proper heat insulation is also demanded, to conserve the heat produced in electric apparatus.

The morning session was concluded by the reading of a paper by Mr. E. Darrow, general superintendent of the Merchants' Heat & Light Company, Indianapolis, in which various kinds of ornamental street lighting were compared, their advantages discussed, and differences in cost shown. Mr. Darrow's company inaugurated the extensive system of ornamental tungsten street lighting in Indianapolis and in preparing this installation had occasion to make a careful study of available systems of illumination, which are outlined in his paper. An abstract of his conclusions will be presented in these columns.

The afternoon session was opened by the reading of a paper relating to municipal ownership in Indiana entitled "Further Education in Central-Station Work," by Mr. R. A. MacGregor, of the Connersville Light, Heat & Power Company. The author advocated employing the same methods which have been so successful in educating the public along the uses of electric devices, to instruct citizens of some of the fallacies in municipal-ownership arguments which may be advanced by over-zealous promoters. Mr. MacGregor drew a dismal picture of a municipal-ownership town.

A paper on the subject of feeder-line regulators was read by Mr. F. W. Shackelford, of the General Electric Company. Induction and switch-type apparatus was described, and some typical recording-instrument charts shown, illustrating the straightening effect of regulators on the voltage curve. Mr. Shackelford also discussed the disadvantages and losses resulting from abnormal and subnormal voltages at distribution points, and demonstrated the close regulation of regulating apparatus when compensated for line drop at a distant point.

Mr. J. K. McDonough presented a paper on methods of introducing current-consuming devices, which had been prepared by Mr. H. J. Mauger, of the General Electric Company. The methods outlined were: Personal solicitation; showroom display; public demonstration; private demonstration; display advertising, and solicitation by letter. After discussing the best applications of these methods, the paper continued with suggestions for keeping apparatus once sold in commission. Many central stations are adopting a policy of perpetual care of appliances purchased through them, realizing that an electric flatiron laid away on a shelf for some trifling defect means a serious loss of revenue. Indeed, the central-station profit begins only after the apparatus has been placed in the consumer's service.

Resolutions on the death of the late secretary, Mr. F. M. Leslie, were adopted and ordered spread on the minutes.

Officers were elected and committees appointed for the ensuing year as follows: President, Mr. F. A. Bryan, South Bend; vice-president, Mr. S. B. Harting, Elwood; secretary and treasurer, Mr. J. V. Zartman, Indianapolis. Executive committee: Mr. R. A. MacGregor, Connersville, chairman; Messrs. E. Darrow, Indianapolis; J. P. Ohmer, Elkhart, and T. F. Grover, Terre Haute. Advisory committee: Mr. C. C. Perry, Indianapolis, chairman; Messrs. T. C. McReynolds, Kokomo, and J. W. Robb, Clinton. Finance committee: Messrs. C. A. Elliott, Muncie; J. A. Moncrieff, Bloomington; Felix Cadou, Vincennes; C. M. Poor, Sullivan, and T. A. Wynne, Indianapolis. The place of holding the next meeting was left to the executive committee.

Kansas Electrical Convention.

The 1910 annual meeting of the Kansas Gas, Water, Electric Light and Street Railway Association will be held at Kansas City, Kan., Tuesday and Wednesday, Sept. 27 and 28. Following the address by the president, Mr. M. T. Flynn, of Kansas City, the following papers will be read:

Boiler-Water Troubles, by Mr. C. C. Young, Lawrence, Kan.—*Electric Vehicles from a Central-Station Standpoint,* by Prof. B. F. Eyer, Manhattan, Kan.—*The Other Fellow,* by Mr. L. O. Ripley, Wichita, Kan.—*Prevention of Accidents,* by Mr. Geo. E. Haylor, Joplin, Mo.—*Co-operation Between Manufacturer and Central Station,* by Mr. Harry G. Glass, Pittsburgh, Pa.—*Financing a Plant in a Small Town,* by Mr. H. A. Walker, McPherson, Kan.—*Rates for Water Works Companies,* by Mr. J. H. Rathert, Junction City, Kan.—*Troubles of a Water Commissioner,* by Mr. Jno. G. Pease, Junction City, Kan.—*Review of Work of Wisconsin Utility Commission,* by Prof. Geo. C. Shaad, Lawrence, Kan.—*Electrical Standardizing Laboratory of Kansas University.*

After reading and discussion of these papers there will be a "Question Box." Mr. James D. Nicholson, of Newton, Kan., is secretary of the Kansas association.

Convention of the Michigan Electric Association.

The seventh annual convention of the Michigan Electric Association was held at the Harrington Hotel, Port Huron, Mich., Aug. 16, 17 and 18. Over 100 were in attendance, about half the number being central-station men and half salesmen. The first session was held on the evening of Aug. 16, Mr. A. C. Marshall, of Port Huron, president of the association, presiding. He assured the visitors, "You'll like Port Huron," this slogan being placed at both ends of the Black River bridge on Military Street, Port Huron's principal thoroughfare, so that all incomers may surely read. Mayor John Bell, of Port Huron, said a few words of welcome, after which the president introduced Mr. J. C. Sloan, manager of the Port Huron Gas Company, who also welcomed the convention.

Mr. Sloan made a few appropriately facetious remarks about the presence of a gas man in an electric light convention. He thought that in the minds of some his presence there could best be desired by the quotation from scripture, "And the devil came also." However, gas and electric men are all public servants together and in this capacity he spoke to them. He said that we must realize our responsibility as public servants. If managers of public utilities apply the golden rule and horse sense it will help them to fulfill properly their obligations. It is sometimes necessary to exercise firmness, but always kindness. He spoke against the policy that some companies have pursued of giving various appliances away to consumers. Such policy makes the public think that the profits of the business are high when a company can afford to do this. He asked how many companies there represented were charging enough for a depreciation account. Dividends which are shown by the books, but not earned, will cause trouble when readjustments are made. He also remarked that a manager who can make a manufacturing enterprises earn 25 per cent dividends is considered a hero, while public service officers who would make their companies earn 10 per cent dividends would be considered as thieves.

President Marshall then delivered his address, in which he called attention to the fact that from 80 to 85 per cent of the plants represented in the association are in towns of from 5000 to 10,000 population. Officers of the association should remember this in arranging its programs. There had been, he said, no radical changes in the electric lighting business in the past year. He called attention to the increased importance of the series-tungsten lamp for street lighting. It is destined to replace arc lamps in many cases. He opposed the system established by the association in past years of giving each president

two terms. He knew that many ex-presidents felt as he did about the matter, that it was better to pass the work and the honor of this office around more rapidly among the men of the State. However, there is naturally considerable delicacy about opposing the two-term idea because of the possibility that it would be taken as a personal matter. President Marshall, in the position of a president who has served one term, felt free to express his convictions this year as he would not two years hence. The time of association meetings was formerly October. In recent years this has been changed to August. However, since Michigan is quite a summer resort State some managers cannot get away in August. Further consideration should be given to the time of meeting. He suggested the adoption of an official badge or emblem which could be used on Association printed matter and letterheads, thereby following the example of other similar associations. The Association's finances are in much better shape than formerly.

He suggested that the Association could do something of real benefit to many of its small members by purchasing some of the more expensive instruments for commercial testing which small members would like to use but cannot afford to purchase; such instruments, for example, are curve-drawing wattmeters, carbon-dioxide flue-gas recorders, etc.

On motion of Mr. R. W. Hemphill, of Ann Arbor, it was voted to have the secretary appoint a committee of three to consider the president's address. The president called attention to the St. Clair tunnel generating plant of the Grand Trunk Railroad in Port Huron as a very fine piece of engineering which members should visit. The session then adjourned.

On Wednesday morning at the opening of the session Secretary A. B. Biggs, of the Detroit Edison Company, read a letter of regret from Mr. E. F. Phillips, of Detroit, past-president and active worker in the Association. Mr. Phillips was confined to his bed and unable to attend. It was voted to instruct the secretary to wire the Association's regrets and a hope for the speedy recovery of Mr. Phillips.

"The Boiler Room and Its Contents" was the subject of a paper by Mr. H. F. Rosenkrans, of Durand, which was followed with a written discussion of the same subject by Mr. H. A. Chase, of Hart. These called attention to sources of waste in boiler-room practice. The subject was discussed by President Marshall, of Port Huron; Messrs. A. N. Richardson, of Ann Arbor; J. R. Cravath, of Chicago; John A. Cavanaugh, of Benton Harbor; R. W. Hemphill, of Ann Arbor, and F. B. Spencer, of Cheboygan.

"Accounting for Central Stations in Small Towns" was the subject of a paper by Mr. F. B. Spencer, of Cheboygan, which was discussed by Messrs. Thomas Hinks, of Mt. Clemens; John A. Cavanaugh, of Benton Harbor, and others. It was voted that the president appoint a committee of three on accounting to report at next convention.

A paper on "The Real Cost of Street Lighting," by Mr. F. R. Mistersky, superintendent of the Detroit Municipal Lighting Plant, was read in the absence of the author by the secretary, as it was announced that Mr. Mistersky was ill. This was discussed by Messrs. Cavanaugh, Cravath, A. D. Furlong, of Pontiac, and others.

A paper giving some experiences in the baking of enamel by electricity was presented by Mr. John A. Cavanaugh, of Benton Harbor. This paper described some large enameling ovens evolved by a large manufacturing concern in Benton Harbor for baking enamel on steel office cabinets. These ovens are proving more economical than steam-heated ovens. After this Mr. Cavanaugh was asked a number of questions about these ovens and his experience with other household baking appliances.

On Thursday morning, at the third and last session, the executive committee announced the following nominating committee: Messrs. F. B. Spencer, of Cheboygan; A. N. Richardson, of Ann Arbor, and Howard Pett, of Big Rapids. The president announced the appointment of a committee on accounting consisting of Messrs. F. B. Spencer, of Cheboygan; Thomas Hinks, of Mt. Clemens, and H. A. Wing, of Adrian.

"Flat Rates for Residence Lighting" was the subject of a paper by Mr. R. S. Stewart, of Detroit, in which he related some successful experiences in small towns with flat rates. The presentation of this paper developed a discussion in which there were decided differences of opinion and which was participated in by Messrs. A. T. Holbrook, of the Excess Indicator Company; F. L. Prindle, of Gladwin; W. H. Friederich, of Coldwater; A. E. Williams, of the National Electric Lamp Association; Stewart, Cavanaugh and others.

A paper on "The Cost of High-Efficiency Lighting," by engineers of the National Electric Lamp Association in conjunction with Mr. George Westover, of Cadillac, was read by Mr. A. E. Williams, of Cleveland. This paper was immediately followed by a paper on "Maintenance of Meters in Small Towns," by Mr. A. N. Richardson, of Ann Arbor. Following the presentation of these papers there was more discussion on the question of meters versus flat rates.

"Tungsten Lamps in Mt. Clemens" was the title of a paper by Mr. Thomas Hinks, of that city. This paper was discussed by Messrs. A. C. Marshall and R. S. Stewart.

OFFICERS ELECTED.

The nominating committee made its report, which resulted in the election of the following officers: President, Mr. John A. Cavanaugh, of the Benton Harbor-St. Joe Railway & Light Company; vice-president, Mr. F. B. Drees, of the Michigan Power Company, Lansing; secretary and treasurer, Mr. Herbert Silvester, of the Detroit Edison Company; executive committee, Messrs. O. L. Wood, of Ionia; James De Young, of Holland, and H. A. Fee, of Adrian.

Mr. Cavanaugh made a suggestion for the holding of the next convention by chartering a boat for a two-day or three-day cruise on the Great Lakes. This plan would be pleasant in hot weather and do away with the distractions of the larger cities.

The treasurer presented a report showing receipts for the year amounting to $1,115.85; expenses, $797.86. Figuring all assets and liabilities of the immediate future the association's finances have about come out even, exclusive of the deficit of two years ago.

The association went into executive session and listened to a talk by Mr. J. V. Oxtoby, attorney for the Detroit Edison Company and other similar interests, on the present aspect of the legal affairs in the State. He outlined the laws affecting electric light and power companies recently passed, one requiring the filing of franchises, frontage consents, etc., with the Railroad Commission, whenever extensions are made, and another requiring approval of the commission for all stock and bond issues. He told some of the things which had and had not been done under these laws. The convention then adjourned.

Abstracts of most of the papers and discussions not found in this issue will be found in later issues.

ENTERTAINMENT FEATURES.

Wednesday afternoon was given over to a boat ride down the St. Clair River. At the Diamond Crystal Salt Works at St. Clair the boat landed to allow the party to visit these large salt works and see the methods of manufacturing, packing and shipment. After this the boat went on down the river and brought the party back as far as Stag Island, where dinner was served at the hotel. From Stag Island the boat went up the river and out into Lake Huron, returning to Port Huron about 10:30 p. m. This method of spending the afternoon and evening was very agreeable in view of the unusually hot, close weather.

On Wednesday morning at 8:30 a trip was made to the plant which supplies energy to the single-phase electric locomotives operating through the Grand Trunk Railway tunnel under the St. Clair River from Port Huron to Sarnia. This plant is a very interesting piece of engineering, which has been fully described in the technical press. The chief feature of interest is the heavy overload which is imposed upon the plant while trains are pulled up the grade in the tunnel, and the very light load on the plant at other times. This condition necessitates automatic control of draft and stokers which speed up as soon as the steam pressure drops slightly with the coming on of the load. After visiting the plant the party made a trip through the tunnel

and back on one of the double-unit electric locomotives, which are equipped with single-phase motors. Mr. W. D. Hall, electrical engineer of the Grand Trunk Railway, piloted the party and explained the features of interest.

On Thursday afternoon the Detroit Edison baseball nine played the Port Huron Independents in a good game which resulted in a score of 4 to 0 for the Detroit Edison team. For the ladies an automobile trip was given on Wednesday morning taking in the Lake Huron beaches, with luncheon at the Windermere Hotel on Lake Huron. On Thursday morning they went on a trip through the Port Huron tunnel, returning by way of the ferry.

THE NEW PRESIDENT.

Mr. John A. Cavanaugh, the president-elect, is superintendent of the lighting department of the Benton Harbor-St. Joe Railway & Light Company. He is 49 years old, was born in Ohio and raised in Michigan. He received a common-school education and started his working career in the boiler and engine room of a woodworking establishment. He then entered the employ of a fruit-packing concern of which he was later made manager. In 1886 he went to the Valparaiso (Ind.) Water Company as engineer, where he remained 10 years. In 1896 he became engineer of the electric light plant in the same town, remaining a short time and then going to Three Oaks, Mich., as manager of the electric lighting company. In 1900 he rebuilt the water-works plant at Fremont, Ohio. From 1901 to 1905 he was superintendent of public works at Niles, Mich, and from 1905 to 1906 held a similar position at Coldwater, Mich. In 1906 he took his present position at St. Joseph and Benton Harbor, immediately following the purchase of the property by its present owners. He has charge of the lighting department of this company and all overhead work and the electric generating and distributing apparatus for both railway and lighting. The gross earnings of the lighting department have been more than doubled since he took charge in 1906.

Massachusetts Commission News.

The Massachusetts Railroad Commission has issued a finding, in the petition of the Boston & Eastern Electric Railroad Company for a certificate of exigency, to the effect that until the Legislature of 1911 makes known its opinions with regard to many important proposed metropolitan improvements further consideration of the petition should be suspended. The majority of the board, represented by Commissioners Bishop and White, state that the question of steam railroad electrification at Boston, and that of a north and south tunnel between the two steam railroad terminal stations, should be considered by the next Legislature before action is taken by the commission upon the Boston & Eastern petition. Another important question is the proposed acquisition of control of suburban railway systems by the Boston Elevated Railway Company, for the purpose of establishing a uniform transportation service in Eastern Massachusetts, and of instituting many operating economies through centralized administration. The Boston & Eastern project has been before the board for about three years, and the Legislature of 1910 passed a law granting it the right to build a tunnel under Boston Harbor and a subway entrance into the city, although the act disclaimed any adjudication of the exigency of the road. The proceedings before the commission have included the most thorough engineering studies that have been brought before that tribunal since it began to deal with electric railway matters. Probably upward of $125,000 has been expended in the preparation and conduct of the company's case to date. The proposed road has been combated by every existing transportation company in the territory. Chairman Walter Perley Hall, of the commission, files a minority report with the majority finding, in which he says: "I regret my inability to agree with the conclusions set forth by my colleagues in the foregoing memorandum. I am of the opinion that the passage of the Acts of 1910, Chapter 630, authorizing the Boston & Eastern Electric Railroad Company to construct a tunnel and terminal in the city of Boston, taken in connection with the whole subject of metropolitan improvements and the action of the General Court of the same year relating thereto, creates a situation that will be in no wise be prejudiced by an adjudication at the present time of the petition of the Boston & Eastern Electric Railroad Company for a certificate of exigency, so-called."

The present finding of the board throws the whole question upon the Legislature of 1911, and the fight will undoubtedly be resumed immediately after the General Court convenes. There have as yet been no hearings held by the several commissions upon the resolves of the last Legislature requiring investigations and report upon a number of important transportation matters at Boston, before the end of January, 1911. The action of the majority of the commission in the Boston & Eastern case opens the question of the influence of steam railroad electrification and other improvements upon the future of high-speed electric interurban railroads to be built under the acts of 1906. There is every evidence that strong pressure will be brought to bear upon the next Legislature to secure the passage of an act requiring the railroads at Boston to electrify within a specified time, regardless of contentions as to the cost of such work. The railroads argue that if the building of new lines like that of the Boston & Eastern is permitted, the electrification of suburban service will be long postponed. Chief Engineer J. H. Bickford, of the Boston & Eastern, announces the purpose of the company to continue its efforts to secure authority to build.

New York Commission News.

The Public Service Commission, of the First District, has received a letter from L. S. Miller, president of the New York, Westchester & Boston Railway Company, suggesting quite a number of changes in the plans of that road. These changes include a more direct route to Clason's Point and to the locality around Throgg's Neck. Mr. Miller also advocates a joint Interborough and Westchester terminal at 180th Street, with a spur to the West Farms elevated station of the subway three blocks distant. The new terminal is to be used by the Westchester road and by the Interborough in common. He also asks that the new company be permitted to use some of the six tracks of the New York, New Haven & Hartford Railroad between Willis Avenue and 174th Street to avoid the necessity of building. As the Westchester line belongs to the railroad company, it was generally understood, at the time permission was given for it to change its route parallel to the railroad, that this request would be made subsequently. He suggests that if the Broadway-Lexington route is finally built, that some sort of an arrangement may be made with it whereby express and local trains can be run from the center of the city over the Westchester road.

Chairman Wilcox, of the commission, has announced that the forms of contract for the proposed tri-borough subway are entirely completed and now only await the approval of the corporation counsel. As soon as this is received, he says, the advertisements for bids will be made.

Maryland Commission News.

Mr. Albert C. Ritchie, assistant counsel of the Maryland Public Service Commission, has informed the United Railways & Electric Company, of Baltimore, that members of the public press are not among those to whom free passes may be issued, and that such passes may be issued to public officials only when they are performing public duties and their transportation would be an expense properly chargeable to the United States, state or municipal government. Policemen and firemen are also excepted when they are in uniform, as they are then presumed to be engaged in the public service, and, therefore, entitled to free transportation. Attorney-General Straus, the drafter of the Maryland Public Service law, has taken exception to this ruling, declaring that the purpose of the law as drawn up by him and his construction of it is to allow no public official under any condition to hold a pass. According to Mr. Ritchie free street car transportation for public officials,

whether city or state, is permissible when the officials are engaged on public business of such a character that they could properly charge the city or state with transportation expenses. The opinion which Mr. Ritchie gave was the result of a request to the Public Service Commission from the United Railways & Electric Company for an interpretation of the section of the Public Service Commission bill which treated of railway passes. Following receipt of the opinion, the company sent out a letter to those who have been enjoying free transportation, stating that since the issuance and use of complimentaries is in conflict with the Public Service Commission law such passes should not be accepted for transportation and coupons of such books should not be tendered to conductors after Aug. 20.

The matter of proposed new rates for telephones in Baltimore will be taken up by the Public Service Commission this week. A reduction of the existing rates has been filed by the Chesapeake & Ohio Telephone Company in pamphlet form with the commission, and a date will be set for a public hearing at which the commission will investigate complaints of users of telephones and take up other matters relating to rates. According to the pamphlet the general reduction is about 15 per cent under those now prevailing on one-party lines for unlimited service. It descends from this until a point is reached where there is no reduction for limited service and party lines. The existing charge for limited service and party lines is not more than $24 per year in the residential section and there are no unlimited telephones in the business section. The average lowering of the cost will be about 10 per cent with the new reduction, but it is understood that this will not apply to those using a restricted call.

Canadian Hydroelectric Commission News.

According to a report from Berlin the manufacturers of that city are getting tired of waiting for the hydroelectric power from Niagara Falls. The transmission line has been constructed to Berlin on Aug. 17, but owing to a missing link between Guelph and the Falls a stretch of 15 miles, not having yet been constructed, power is not expected to be delivered to Berlin until Sept. 1.

The commission, through Hon. Adam Beck, chairman, is advertising for tenders for the construction of a transformer station to be built at Port Credit for the purpose of serving the district between that town and Toronto, as well as supplying, through a branch line, Brampton, Milton, Georgetown and Mimico.

The Town Council of Ingersoll, at a special meeting on Aug. 16, adopted the report of the electric light and power committee recommending the acceptance of the tender of the Canadian General Electric Company for transformers for the step-down station, costing $4,600; switchboard, $3,500, and other equipment to a total of $10,780.27, and the Mayor was authorized to notify the company through the town's engineers, Messrs. Ross and Holgate, of Montreal. The report also recommended the construction of a substation, and that plans and specifications be prepared.

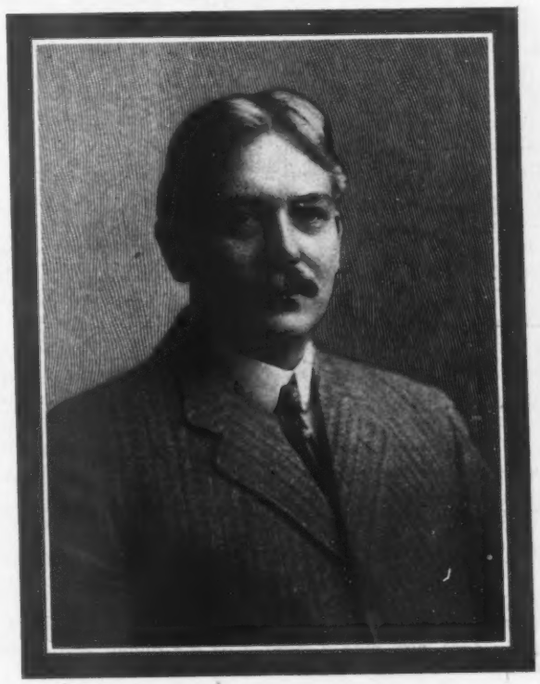
AMERICAN ELECTRICAL ENGINEERS—XI.

John L. Harper.

Mr. John Lyell Harper was born in Harpersfield, Delaware County, New York, Sept. 21, 1873. The pioneer settlers of that section, from whom he is descended, received the township of Harpersfield from the English Government early in the eighteenth century. His early education was obtained at Stamford Seminary, Delaware County, from which institution he was graduated in 1893; receiving a State scholarship to Cornell University, he matriculated there the same year and was graduated in 1897 with the degree of M.E. Mr. Harper then went to Seattle, Wash., where he entered the employ of the Oregon Improvement Company as draftsman. Realizing the prospective development in the electrical field, he obtained employment with the Union Electric Company, of Seattle, working as an electrician in its shops until 1898, when he went to Minneapolis, Minn., to accept a position with the Twin City Rapid Transit Company. This company operates the traction lines of Minneapolis and St. Paul, the power supply being obtained principally from a hydroelectric plant at St. Anthony's Falls.

The traction company had about 20 miles of 12,000-volt, three-phase cable in service, and Mr. Harper made an extended study of the electrolytic effects of the ground returns of the trolley systems upon the water and gas pipes, as well as upon the lead sheaths of the underground transmission systems. He made plans for remodeling practically all of the switchboards of the main hydroelectric station and the five substations operated by the company. Later, he was made operator of the main plant, which position gave him opportunity to study methods of handling frazil and cake ice in the Mississippi River, and also their effect on the operation of a hydraulic plant.

In 1889 he was employed by Messrs. Floy & Carpenter, consulting engineers, to represent them as inspecting engineer during the construction of a hydroelectric plant and transmission system then being built for the St. Croix Power Company at Apple River, Wis. In 1900 he was given full charge of the construction work, upon the completion of which he became superintendent of the power plant and its transmission systems,



Mr. John L. Harper.

which position he held until 1901. Energy from this plant was transmitted at 25,000 volts a distance of 30 miles to St. Paul, Minn.; three miles of the transmission circuit is within the city limits of St. Paul in the form of underground three-phase cables, and furnished the first example of underground transmission on a large scale at such a high voltage.

In 1902 Mr. Harper became assistant engineer of the Niagara Falls Hydraulic Power & Manufacturing Company, of Niagara Falls, N. Y., and the following year was made chief engineer of the same company, which position he still holds with its successor, the Hydraulic Power Company, of Niagara Falls, together with that of chief engineer of the Cliff Electrical Distributing Company of the same city. The Hydraulic Power Company owns the surface canal power development on the New York State side at Niagara, the plant being one of the earliest and most notable hydroelectric systems of the world, while the Cliff Electrical Distributing Company was recently organized and has taken over the extensive electrical generating and distributing system in Niagara Falls and vicinity.

In 1902, when Mr. Harper became connected with the Niagara Falls Hydraulic Power & Manufacturing Company, the devel-

opment was about 20,000 hp, while to-day this development is 125,000 hp. During these eight years of remarkable activity and growth on the part of the company, Mr. Harper has had full engineering charge of all the hydraulic, mechanical and electrical work. Station No. 3 of this system represents the latest ideas in this field. It is planned to contain 13 10,000-hp turbines when completed, its present capacity being 90,000 hp. It is without doubt one of the most efficient hydroelectric developments in existence, an actual hydraulic efficiency of 90 per cent being obtained between head water and tail water. The rotating parts of the horizontal type generators in this station weigh 50 tons, and for the proposed speed of 300 r.p.m. it was found that no bearings had thus far been built adapted to this weight and speed. As a consequence, Mr. Harper made an extended original research and investigation to determine the proper elements of design. The electrical generating and distributing systems now installed are models in simplicity, flexibility and ease of operation.

While in Minneapolis and Apple River Mr. Harper had exceptional opportunities to study the formation of ice, its handling, as well as its effect on hydraulic operation, which knowledge proved valuable at Niagara. Lake Erie discharges vast fields of ice into the Niagara River, and these when transported by the currents to the Falls are a menace to the generating plants there, to overcome which requires much engineering skill. Under Mr. Harper's direction diverting works have been constructed in the intake from the river and at the power plants, with the result that the Hydraulic Power Company operates continuously during the winter season despite the extremely adverse ice conditions above referred to.

Since Mr. Harper has been in Niagara Falls the far-reaching and all-important question of the preservation of the scenic beauty of Niagara has come strongly into public notice, and he has represented his company in an engineering capacity before Congressional committees in connection with this movement. Through him the Hydraulic Power Company has taken a leading part in the improvement of the Niagara gorge view, and Mr. Harper has had the direction of the expenditure of large sums of money to accomplish scenic results. Among other details in this connection, he designed and built a rough rubble facing wall over 200 ft. high, 14 ft. thick and 500 ft. long, which completely conceals the power development structures of his company and returns the face of the cliff to its original appearance.

In addition to his larger engineering work, Mr. Harper has given attention to the development of the electric furnace, and has invented a type especially adapted to the needs of the ceramic industry. With this furnace it is possible to fire the finest porcelain insulators and china in as many hours as formerly days, and with a control of the higher temperatures heretofore impossible.

As an indication of the breadth of activity of Mr. Harper, it may be mentioned that he is engineer of the Niagara Falls Grade Crossings Commission, which has important work on hand; a member of the Niagara Falls Industrial Commission; president of the Young Men's Christian Association of Niagara Falls, and in addition acts as consulting engineer to a number of corporations and municipalities. He is a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Society of Civil Engineers, American Electrochemical Society, American Ceramic Society, American Society for the Advancement of Science, National Geographic Society and American Civic Alliance.

CURRENT NEWS AND NOTES.

Gasoline-Electric Truck Performance.—On the Indianapolis motor speedway, Aug. 16, a 5-ton gasoline-electric commercial truck attained a speed of 26 miles an hour carrying 9000 lb. of gravel in sacks. The day before a similar truck, acting as a tractor for six wagons, moved a total load of 50 tons. These trucks have a gasoline engine direct-connected to an electric generator from which energy is distributed to motors at the axle of each of the four wheels. The trucks were built by the Universal Motor Company, of Indianapolis.

Meter Tests.—The New York City Public Service Commission reports that of 30 electric meters tested on complaint in July one ran fast, two were slow and 28 were within the legal limit of accuracy.

Valuation of Telephone Plants.—The Department of Public Utilities of the city of Seattle has employed Mr. Frank B. Hall, of Wheeling, W. Va., and Mr. C. H. Judson to make a valuation of the two telephone plants in that city—the Pacific Telephone & Telegraph Company and the Independent Telephone Company—and to report if the companies are at present charging fair and equitable rates. The result of the investigation will be brought before the Washington Railroad Commission on Sept. 26, at which time the report of the commission's engineer on the Independent Telephone Company will be presented.

The Modern Way of Ridding a Dog of Fleas.—Dog fanciers realize the difficulty of separating the animals from the fleas which often inhabit them. Few of the older methods are entirely satisfactory, but a Chicago electrical man is authority for the statement that the use of the vacuum cleaner is most efficacious. This man has a pet dog which is troubled with fleas, and at intervals he has considered it his duty to endeavor to relieve Ponto of the parasites by the time-honored water method, partly immersing the animal in water drawn in the bath tub and laboriously pursuing the elusive insects to a watery death. But one day he had a brilliant idea and he tried the effect of the vacuum cleaner, using a small nozzle and carefully going over the dog's skin and hair. Ponto did not like the operation very well, but he has been free from fleas ever since. The vacuum removed not only the full-grown insects, but their eggs as well, and the experiment has been a complete success apparently.

International Telegraphic Contest.—The Italian Minister of Posts and Telegraphs has arranged for an international telegraphic tournament to be held next year at the Turin international industrial exposition. Those desiring to enter the contest should apply not later than June 11, 1911, to the secretary-general, Minister of Posts and Telegraphs, Rome. There will be three contests, namely, with Morse key and sounder or recorder; with the Hughes apparatus and with the Bandot quadruplex apparatus. The time for the Morse trial is 20 minutes and an hour for the Hughes and Bandot trials. Individual prizes will consist of gold and silver medals and objects of art. A champion prize cup will be competed for by those who have won a prize in each of the three contests, and a cup will be awarded to the country which carries off the most prizes. A pamphlet giving full details of the contest can be obtained upon application to the above-mentioned address.

Colorado Electric Club.—At the electrical lunch on Aug. 18 of the Colorado Electric Club, at which 120 were present, ex-Governor Thomas, of Colorado, was the speaker. He made a very convincing plea for the proper restitution by the state to the holders of former state warrants, which constitute the so-called "repudiated debt of Colorado." He related that the credit and integrity of the commonwealth were those of the individual citizen, stating that a reflection against the good faith of the commonwealth could not fail to be injurious to each stockholder citizen. One hundred and twenty converts will be active supporters of a coming constitutional amendment of the state authorizing bonds for the payments of state warrants. This matter has been a very sore one for years among many Eastern investors of these warrants, and has aided in depreciating the credit of Colorado. A reversal of this condition is hoped for as a result of the fall election.

Electrical Business of St. Louis.—The Merchants' Exchange of St. Louis estimates that St. Louis does a business of $12,000,000 a year in electrical goods. This includes apparatus manufactured in St. Louis and electrical machinery and supplies made elsewhere and distributed from St. Louis. In addition the value of cars made in St. Louis for electric railways is placed at $3,500,000 a year.

Wireless for Airship.—An airship on which Walter Wellman promises to cross the Atlantic is being fitted with a Marconi wireless equipment. Mr. J. R. Irwin, the wireless operator of the S.S. *St. Louis,* has been assigned to the dirigible station. The latest announcement of Wellman is that he will start on the transatlantic trip in September.

Municipal Plant Proposed for San Bernardino.—The San Bernardino (Cal.) City Council has declared in favor of a municipal lighting plant, and the Mayor has appointed a committee of the Councilmen to start proceedings. This action was taken as the result of a resolution adopted by the Merchants' Protective Association, which declared for a lighting system owned and operated by the city.

Outing of St. Louis N. E. L. A. Branch.—On Wednesday evening, July 27, the St. Louis Section of the National Electric Light Association, which is composed of employees of the Union Electric Light & Power Company, making, with their friends, a party of about 600 in all, enjoyed a moonlight Mississippi River trip on the steamer *Alton,* which had been chartered for the occasion. There was dancing on board, and refreshments were served. Those who enjoyed the occasion are anticipating with pleasure the date of the next outing.

Right-of-Way for Pole Lines at Rear End of City Lots.—The Realty Board and representatives of the electric service and telephone companies of Los Angeles are endeavoring to extend the plan of reserving a 4-ft. right-of-way in the rear of lots in new tracts for poles to be used by all the electrical corporations, thus removing them from the streets. A form of easement will be prepared which, if approved, will be inserted in all new deeds of lots. Owners and agents of real-estate subdivisions where lots have been sold with this provision in the deed report that the plan has proved advantageous, as prospective home-builders are anxious to locate on streets free from poles. Of course, in cities having alleys between streets this provision would hardly be necessary.

Joseph Henry as a Diner-Out.—An interesting anecdote of Joseph Henry is contained in a recent article by Mr. Jasper Alban Conant, the painter, who gives in the *Metropolitan Magazine* reminiscences of a visit to Washington in 1861 and 1862. Mr. Conant says: "I met Prof. Joseph Henry, of the Smithsonian Institution, who arranged with me to restore and varnish some of the pictures in the government collection. Henry, besides having done more for the development of electricity in America than any man since Franklin, had even a European reputation in other branches of science. Yet he was a keen disappointment to Bates [attorney-general in Lincoln's cabinet], I remember; for the first night the brilliant physicist was invited to dine, the only person he talked to was a ranchman just back from Texas whom he plied with questions about swamp-hogs and some ancient mounds."

The "Trouble Man" in St. Louis.—An interesting feature of central-station work in large cities is supplied by the alert resourcefulness of the "trouble department," which is open for business 24 hours a day, with no holidays and no vacations. In St. Louis, for instance, the Union Electric Light & Power Company has an "ambulance corps" of 23 men, with three automobiles and one wagon. These men are on duty to answer all reports of trouble, scattered throughout the city wherever wires run to carry electricity. As soon as a troubleman has finished a job of repair work, he telephones headquarters and gets his next order. Every fire alarm is sounded in the Union Electric headquarters and to the scene of every fire is sent at least one member of the "trouble platoon." Every half hour the trouble man must telephone to headquarters and report where he is and what he is doing.

Electric-Steam Heat for Pennsylvania Tunnel Trains.—For use during cold weather, when the trains of the Pennsylvania Railroad entering the New York station through the electrified tunnel zone are disconnected from their steam locomotives and taken across the Jersey meadows and through the tunnels by electric locomotives, steam generated in electric boilers will be used to maintain the temperature in the cars and to keep the train connections from freezing. These boilers will utilize the 600-volt direct current from the third rail, and will have a capacity for generating 1000 lb. of steam at 80 lb. per square inch pressure, each hour. Their output will be connected into the regular train steam line, and will be of service principally in protecting the cars against the windswept run across the Hackensack meadows after the electric locomotives are hitched on at the Harrison terminal. The tunnels themselves will, of course, remain at practically a mean winter temperature throughout the cold weather.

Electric Energy Distribution in Northern Italy.—Work is progressing rapidly on the 9000-hp station at Ponte della Serra in the Province of Belluno, under the direction of three electrical companies, one of which is the Edison (Italian company), the central office of which is located in Milan. The Milani hydroelectrical plant, near the city of Verona, producing 10,000 hp, was put in service in November. The electrical equipment was supplied by the Westinghouse Company of Havre. Electric car lines are springing up in all parts of this district, enormously stimulated by the cheap electric energy. The State frequently subsidizes these companies, as in the case of the line from Belluno to Pieve di Cadore, which will receive $115 per kilometer (0.62 of a mile). Railroad activities are also progressing. The line from Bologna to Verona is nearing completion, much to the regret of the citizens of Padua and Vicenza, for these cities will be cut off from the international line to and from Milan and Bologna, and incidentally Venice will lose many visitors who have been accustomed to stop off at Padua and pay a little visit to Venice before proceeding north or south. A new road from Belluno will penetrate the Dolomites at Lavaredo, and be extended to Toblach, in Austria-Hungary, thus opening up another means of communication with central Europe.

Purdue Electric Special for Central Stations.—Taking a hint from the agricultural department of Purdue University, which each year runs a "corn special" train through the farming region of Indiana, having cars equipped as auditoriums and exhibit rooms where lecturers demonstrate improved methods of planting and farm culture, Prof. C. F. Harding, head of the school of electrical engineering, has suggested to Indiana central-station men that Purdue's electric test car might be equipped as an exhibit-on-wheels of industrial and household electrical appliances and operated over the electric interurban lines of the state for the instruction of users of electrical energy. At the meeting of the Indiana Electric Light Association at Indianapolis, Aug. 17, Professor Harding explained that the car might be fitted with machinery for making both alternating and direct current of commercial voltages available for the operation of small-motor applications and various lighting loads. Thus equipped, the car could make stops at points wherever possible electric-light users could be found, and with lecturers aboard to explain the use and operation of the apparatus, the test car would be of much educational value among the non-electrical people of the state, besides its present service as the subject of electric traction tests which the engineering school is making.

Pacific Coast Electrical Exhibition.—Arrangements are now nearing completion for the Pacific Coast Electrical Exhibition to be held in San Francisco from Sept. 17 to 24. About 75 exhibitors have already engaged booths for the occasion.

Convention of Alabama Association.—The third annual convention of the Alabama Light and Traction Association will be held at Anniston, Ala., Nov. 21, 22 and 23, 1910. Mr. George S. Emery, 11 North Royal Street, Mobile, Ala., is secretary of the association.

Extension of Metropolitan "L" in Chicago.—The Metropolitan West Side Elevated Railway Company, of Chicago, will extend the Douglas Park division of the road from South Forty-eighth Avenue to Lombard Avenue. The new line must be in operation before Aug. 1, 1912, and there will be stations at South Central Avenue, Austin Avenue and Lombard Avenue.

Chicago Meeting of American Electrochemical Society.—Arrangements have been made to hold the general meeting of the American Chemical Society in Chicago on Oct. 13, 14 and 15 at the Hotel La Salle and the University of Chicago. The sessions of the first two days will be held at the hotel and of the last day at the university. A number of papers will be read, and there will be excursions to points of technical interest as well as purely social entertainments. Mr. A. B. Marvin, 950 Commercial National Bank Building, Chicago, is the secretary of the local section.

Electric-Light Plants in Indiana.—From a survey of the electric light plants in Indiana, recently made by Mr. J. V. Zartman, secretary of the Indiana Electric Light Association, who wrote to the treasurers of the various counties of the state, 240 central stations are now in operation. Of this number 175 plants are owned and operated by private companies, the remaining 65 stations being municipal plants. About one-half of the electric light companies in the state are represented in the Indiana association.

New Hampshire State Prison Discards Candles for Electricity.—The warden of the New Hampshire State Prison on Aug. 17 banished the flickering and smoking candles heretofore used in that institution and in their stead 4-cp tungsten lamps illuminate the 186 cells. The lighting hour has also been extended from 8 p. m. to 8:30 p. m. The energy for the installation is supplied from the mains of the Concord Electric Company and the cost is not more than that previously paid out for candles.

Aurora-De Kalb Electric Railway.—Aurora and De Kalb Ill., are now connected by an interurban electric railway. These cities are about 30 miles apart, and a service of one car every hour and a half is maintained. Aurora, which is 40 miles west of Chicago, has become an electric railway center, with lines radiating to Chicago, Elgin, Joliet, Yorkville and De Kalb. These lines carry not only passengers, but a large variety of farm products, including milk.

Gas Testing in Chicago.—A gas-testing station in charge of the Department of Electricity has been in service for some time in the City Hall of Chicago. Preparations are now under way for the establishment of three outside gas-testing stations to be placed on the North Side, West Side and South Side. These stations will be located at 3547 Janssen Avenue, 1841 West Twelfth Street and 5441 South Halsted Street. Working from these centers samples of illuminating and fuel gas will be taken by employees of the department at different places and brought to the nearest station for examination. The test consists of chemical analyses of the gas, photometric tests and tests to determine the pressure of the gas. As far as possible, the tests will be conducted at the stations. The work at the gas-testing stations is quite distinct from the municipal testing of gas meters, and relates entirely to the testing of the quality and pressure of the gas itself.

Prevention of Electrical Accidents to Persons.—The Department of Electricity of the city of Chicago, in charge of Mr. William Carroll, city electrician, is collecting information relating to accidents to persons from electrical causes, with a view of ultimately preparing a set of rules designed to prevent personal injuries from electrical installations. This work, which has been under way for some time, is in direct charge of Mr. Victor H. Tousley, chief electrical inspector. When a human being is killed or injured by means of electricity, the accident is referred to an electrical engineer, who makes a study of the conditions which caused it, and all the attending circumstances. A record is kept of the data thus secured in the case of electrical accidents to persons, and from this material it is hoped in time that some code of rules may be devised. It is reported that the United States government is also working along the same lines, although in this case seeking to prepare a code of rules to prevent dangers both from fire and from accidents to persons.

Low Water Causes Smoking Chimney.—An electric light company in a Western city was recently summoned into court on the charge of violating the anti-smoke ordinance by permitting dense smoke to escape from the chimney of its power station. The manager pleaded in extenuation that the low water in the river running through the city was the cause of the occurrence. The judge was surprised at this novel excuse, and for a moment appeared to deliberate whether the defendant should not be fined for contempt of court. The electrical man hastened to explain, however, that the water in the river was at such an unprecedented low stage that when a water-power company a few miles up the stream manipulated its head-gates to divert the water to its own use the effect was noticeable at the witness' steam-power plant. This diversion bared the electric light company's intake for condensing water, so that it suddenly became necessary to run the plant non-condensing. This, in turn, involved the "firing" of cold boilers, and it was this operation that produced the dense volume of smoke. The judge listened to this explanation attentively and after a brief deliberation imposed only the minimum fine.

Fireman Gets Shock When Hose Stream Is Shut Off.—During a fire on the elevated structure of the Metropolitan West Side Railroad, Chicago, Aug. 13, one fireman armed with a hose-stream, supplied by a steamer, did very effective work in playing water on the seat of the fire, which was near the third-rail. From time to time the water struck the charged rail, and though he was at first apprehensive, the fireman felt nothing, and finally took courage to turn the stream of water directly on the 600-volt third-rail, where it would do the most good in drowning out the burning platform. After the blaze was entirely out, the order was given to shut off the water pressure, and just as the stream from the nozzle fell short of the rail, the man holding it received a severe shock which made him sway perceptibly and almost fall from the structure. At the time he was standing on the water-soaked wooden planking of the structure, over which there must have been considerable leakage from the damaged insulators supporting the third-rail. While he kept the nozzle directed on the rail doubtless the small current which flowed over the moving stream and through the hose to the ground on the water mains kept the nozzle at a potential so near to that of the charged platform that he felt nothing. But when the connection through the nozzle stream was interrupted, the man received the full effect of the difference in potential between the charged planking where he was standing and the ground provided by the water in the hose line. The fallacy about the danger of turning a stream of water on a trolley wire has been exploded for some years, or ever since some one had the courage to try the experiment and discover what really happened. It is more surprising, however, to the lay mind, at least, when a man gets hurt by withdrawing from danger.

THE ARIZONA POWER COMPANY.—II.

Description of the Generating Station, Electrical Operation, Transmission Line and Substations.

By R. S. Masson.

IN the issue of Aug. 18 the history of the hydroelectric development of the Arizona Power Company, of Prescott, Ariz., was given, and all the works, including concrete flumes, pipe lines, syphons, tunnels, etc., incident to bringing the water from Fossil Creek to the site of the generating station on Verde River, described. The present article is devoted to the generating station, substations and transmission system and includes an account of the very simple switching arrangements and the method of operating the system.

POWER HOUSE.

The power house, located on the Verde River, is constructed of rubble concrete. The building is 30 ft. wide, 72 ft. long and 16 ft. high to the crane runway. The transformer house adjoins it and is 16 ft. wide and 60 ft. long.

The entire electrical equipment was supplied by the General Electric Company. Each of the three 1800-kw generating units is complete in itself with transformers, measuring instruments, overhanging waterwheel mounted on one end of the two-bearing generator shaft, and an exciter overhanging on the opposite end of the generator shaft.

There are no switches in the generator leads; each generator connects directly to its own bank of transformers. No attempt is made to run these machines through any bus system or other parallel connections, excepting to connect the high-tension side of the transformers of each unit to either or both of the transmission lines. The entire arrangement of the station is exactly as though three stations, each with one generating unit, were located at points along the transmission line. This plan is adopted on account of the wonderful success which has always accompanied a single-unit generating station, and, of course, the objection to the single-unit stations is removed by having the other two units close at hand. There is, however, a small set of switches and buses which can take energy from any generator for station use and this bus and these switches are used to hold the generators in synchronism temporarily when starting up, until the main line switches are closed. This avoids the strains incurred in closing high-tension switches with machines slightly out of step, causing surges. There are no exciter buses or switches of any kind in the exciter or field circuits, making the operation as simple as direct-current opera-

Fig. 2—Power House and Penstock Line.

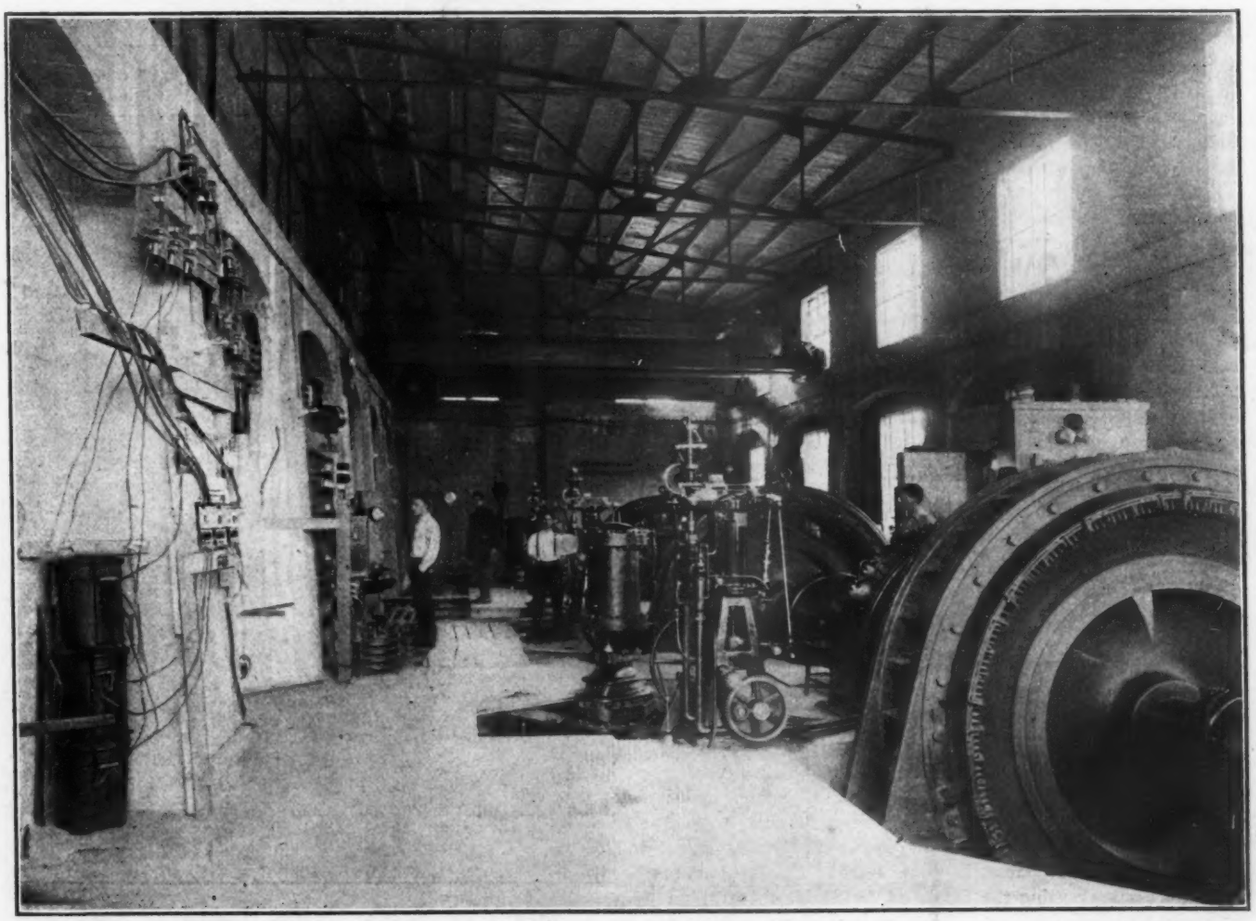


Fig. 1—Interior of Generating Station of Arizona Power Company.

tion. A special Tirrill regulator with three sets of contacts was provided to operate these exciters whenever they are working on the same transmission system; the pilot pressure is taken from the small station bus.

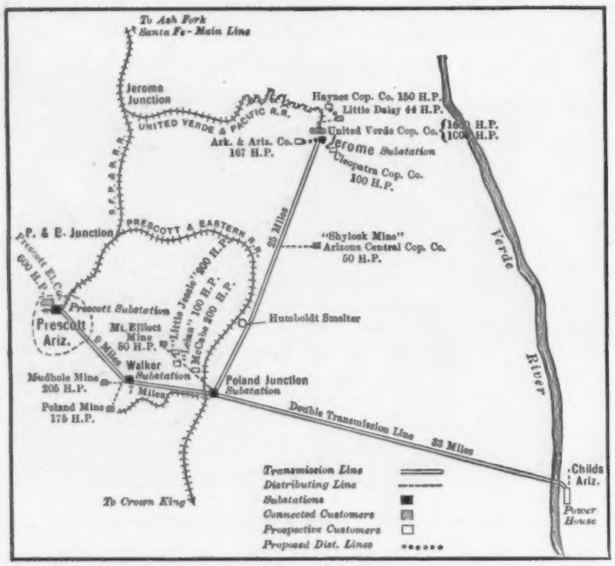


Fig. 3—Map of Transmission System of Arizona Power Co.

Each bank of transformers is provided with two 45,000-volt Kelman switches on the high-tension side, one connecting to the north line and one to the south line. Each switch is located in a separate room and each bank of transformers is located in a separate room. The transformer and switchrooms are separated from each other and from the generating room by high concrete fire walls, but the roof over these concrete rooms is made of wood and covered with rubberoid roofing. This plan of construction is based on the assumption that if either transformer oil or switch oil has once been raised to a temperature sufficient to ignite it, it is absolutely impossible to extinguish the fire unless air can be excluded or a sufficient amount of water or other cooling medium be placed thereon to lower its temperature. No attempt was made to introduce an air-tight system on account of the extraordinary expense of wall bushings and other devices incident thereto.

A hydraulic giant, similar to those so familiar in Western hydraulic mining enterprises, is located on the hill above the power house on the side toward which the transformer and switch houses open. When a fire begins in a power house, there are always one or more operators who would be particularly pleased to have an opportunity and a just cause for leaving the scene of activity and those men voluntarily and quickly man the hydraulic giant and turn a stream taken directly from the main pressure pipe on to the roof of the burning switch or transformer room. Drainage is so arranged that this water will not affect the balance of the rooms and in this way a fire which might otherwise be serious is promptly handled and usually without any very bad results, and possibly without shutting down, though this is not likely.

WATER WHEELS.

Each generator is equipped with a 3000-hp waterwheel of the impulse type, made by the Abner Doble Company, of San Francisco. A specially interesting feature of this equipment is the regulation of the speed by needle nozzle throttling of the stream, which is satisfactorily done in spite of the long pipe and high head, by using the Doble needle nozzle form of automatic by-pass relief valves. The by-pass is a needle nozzle similar to the one used on the main wheel and about half the size. Its needle is attached to the governor through the dash-pot and in such a manner as to produce an inverse motion, opening when the main nozzle closes. The dash-pot is similar to the regular arc-lamp dash-pot, allowing easy motion when the governor attempts to close the relief nozzle and acting very slowly when the governor attempts to open the relief nozzle. The needle of the relief valve is forced toward the closed position by the action of the water and some heavy springs, and it is pulled open by the dash-pot. Two dash-pot needle regulating adjusting valves, one located near the center and the other at the end of the stroke, allow the operator to regulate the speed of closing in two sections. Thus he may allow the relief valve to close quickly during the first half of the stroke and then slowly close the balance of the way.

By adjusting these by-pass nozzles to a proper time period the tendency of the governor to fluctuate with the period of pressure fluctuations in the pipe is easily interrupted. The amount of water thus discharged through the by-pass needle is a very minute fraction of the total amount of water used as this opening of the by-pass can be so arranged that it will only occur for considerable movements in the main needle, and need not occur at all on small changes of load, and the water economy is, therefore, not seriously lowered by this device. The usual Lombard oil-filled governors, with a motor-driven pump and an entire equipment of tanks, etc, for each unit, operate these needle valves.

SYSTEM OF ELECTRICAL OPERATION.

Many years ago the writer was particularly disturbed upon entering a substation of a very large Pacific Coast transmission company by the following notice: "If the power goes off, open all switches and telephone to the chief operator, Mr. ———— at ———— for orders." Thereupon the writer devised the plan used here and which is now in use on all Huntington systems in southern California, which includes more than 12 power houses and 30 substations in one operating combination, all electrically connected.

This plan again reverts to the wonderful success which accompanied not only single generating stations, but single transmission lines. One of these plants with a single generator and

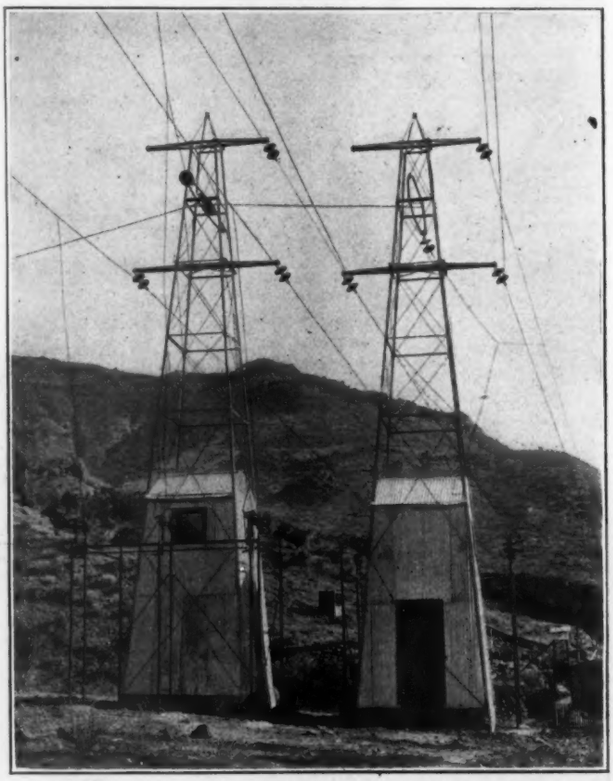


Fig. 4—Lightning Arrester Houses in Base of Transmission Towers.

a transmission line, 30 miles in length, with a 15,000-volt transmission, during the years 1897 to 1899, operated for 33 months without an unforseen interruption to the service and the electricity was off the line only four times during that period. The writer's plan, therefore, of operating a transmission system as though there were two separate and distinct transmis-

sion lines doing separate and distinct work, grew from this idea. A further consideration which led to this plan was the fact that of all the troubles experienced in the transmission of energy up to that time, 85 per cent of the interruptions which

Fig. 5—Transmission Line Below River.

had occurred were due to troubles in switches themselves and not less than two-thirds of these interruptions were due to the accidental or unintended opening of automatic switches and circuit-breakers, due to error and not to any short-circuit or heavy current.

After connecting up several power houses and substations without automatic switches of any kind anywhere on the system (all apparatus, of course, being alternating) the rule posted in the substation differed materially from that quoted above, and was as follows: "Run each of your banks of transformers on one line only, dividing between two lines as near as possible. If the power goes off on one line throw on the other. *Quick!* Take power from either line as you see fit."

The result is simple; the operator at the power house notes a short-circuited line. His line ammeters indicate that one or

Fig. 6—Walker Substation on Prescott Line.

the other of the lines is short-circuited. (Only one generating plant in the entire system is allowed to connect the two lines together; all other plants, whether generating stations or substations, operate with each bank of transformers on one line only. The master plant, therefore, controls the situation. All of the generators in that plant are operating on both lines, each generator through its own transformer.) If trouble occurs on one line, the operator opens the transformer switches, disconnecting all of his generating units from the said short-circuited line. This relieves the load on the generators considerably, probably about half (never all), but immediately the various substation operators, acting without telephone orders, throw in their loads on this generating system and if there are other generating stations, the operator immediately synchronizes the generators which were on the dead line, and throws them onto the live line and thus all substation loads and generators come back at approximately the same time.

In many instances on the Huntington system the entire outfit was transferred from divided lines to one line of the system within two minutes. Substations usually made their change inside half a minute, and frequently in 10 seconds or less. Thus induction motors are usually supplied with energy before they loose a perceptible amount of their speed. In cases of very long lines, where it is inconvenient to proportion the load evenly between the two lines for maximum economy, a single automatic switch is connected directly between the two lines at some remote point, and as this switch can be adjusted for a maximum current amounting to the difference between loads it opens immediately upon the occurrence of a short-circuit on either line, leaving the system separated as above.

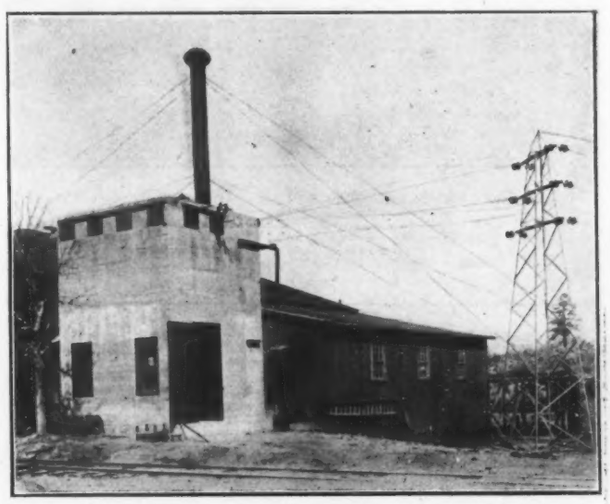


Fig. 7—Prescott Substation and Station of Prescott Gas & Electric Company.

Where all loads and generators are thus transferred to the good line the operator of the master power house starts up a spare generator or takes one of the generators from regular service and slowly brings up the voltage on the line which is in trouble. This avoids all shock and surges on both apparatus and line insulators. If the line shows clear he immediately connects all generators to both lines and the operator at each substation seeing the pilot lamps bright on both lines returns to the original arrangement. After this is all over and the load is again adjusted between the two lines as before, telephoning begins for social purposes as usual, but it is in no wise connected with the operation of the plant except making reports or to arrange with line men for repairs, etc.

TRANSMISSION LINE.

Two tower bases are enclosed for lightning arrester houses and in them the General Electric electrolytic lightning arresters are located, the horn-gaps being located outside on the usual racks.

The transmission line is composed of steel towers, 45 ft. high with three wires in a vertical plane, on each side of the towers and a steel messenger wire for lightning protection running over the peak. The line wires are 5 ft. apart vertically and 10 ft. horizontally; the messenger wire being located over the center and 5 ft. above the upper line wires.

Double Thomas 15-in. hock and-eye type insulators are used. Thirty-five miles of the line is composed of No. 1 B. & S.

seven-strand wire. The two branches 16 and 24 miles respectively from the junction are composed of No. 4 B. & S. three-strand wire running to Prescott and Jerome. Towers were supplied by the United States Wind Engine & Pump

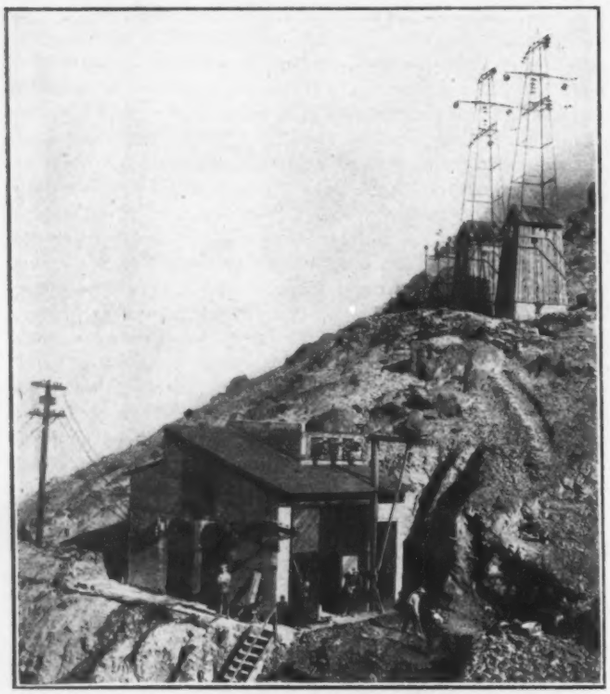


Fig. 8—Jerome Substation and Lightning Arrester House.

Company, Batavia, Ill., and are of the usual rectangular rod and angle-braced windmill type. The wire hardware between insulators and copper is composed of a pair of iron blocks bolted together with four bolts similar to the old bolted come-along which is in turn supported by a link. This clip prevents the slipipng of the wire and at the same time is flexible and allows for a change in the position of the insulator without in any way kinking the wire.

SUBSTATIONS.

Fig. 6 shows a typical substation constructed at Walker, Ariz. These substations have separate switchrooms on the upper floors and transformer rooms below. Each bank of transformers has a high-tension switch connecting to each line. By killing one of the transmission lines from the adjacent substation or the power house, these rooms are rendered entirely safe by opening disconnecting switches underneath the ceiling of the ground floor. The map given in Fig. 3 shows the location of the various substations. For purposes of distribution the line voltage is reduced to 11,000 volts in the substations and delivered to customers at 440 volts, 60 cycles, three-phase.

It is worthy of note that in the entire course of construction there was not a single accident involving serious injury or loss of life. This is remarkable in view of the very large amounts of powder used in blasting. Every pound of material used in the construction was hauled by teams a distance of from 2 to 50 miles; the total amount being 50,000,000 lb.

SERVICE RENDERED.

Two thousand horse-power is now being supplied to the United Verde Copper Company at Jerome, 600 hp of which is transformed into direct current by a General Electric 500-kw rotary converter. Several mines are being supplied with energy and the entire load of the Prescott Electric Company is being carried by the plant. Extensions of distribution lines are being made in many directions from the regular substations located on the transmission lines. The energy is carried at 10,000 volts on three-wire lines erected on wooden poles; this form of construction being adopted in order to faciliate easy moving in the event of changes in the mining location. Steel structures are only used where permanent consumers are located.

The financial interests of the Arizona Power Company have been in the hands of William P. Bonbright & Company, New York. The system was designed and constructed and is now operated by the Electric Operating Construction Company, New York, Messrs. Viele, Blackwell & Buck acting as consulting engineers for the enterprise.

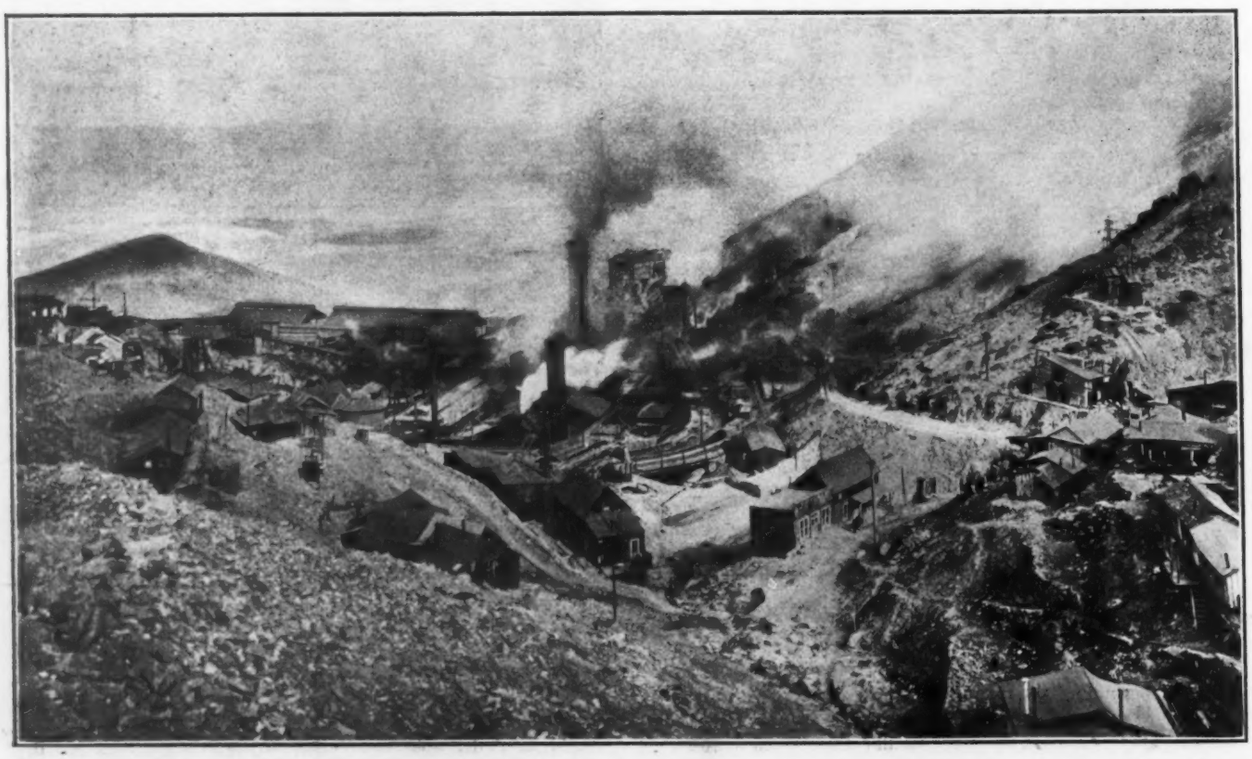


Fig. 9—United Verde Copper Company's Smelter, and Jerome Substation at Right.

A MICHIGAN HYDROELECTRIC DEVELOPMENT.

Water Power Plant of Unusual Design for Sturgis, Mich.

Several novel features have been incorporated in the design of the hydroelectric plant on which the city of Sturgis, Mich., has started construction, to utilize a 25-ft. fall in the St. Joe River, near Centerville. The site of the new station is 20 miles distant from the municipality of Sturgis, which will construct and operate it, transmitting energy for sale to its own citizens

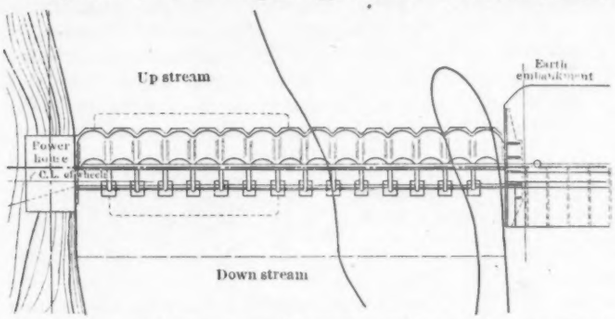


Fig. 1—Plan of Spillway and Generating Station on St. Joe River.

and disposing of the remainder of the output among the neighboring towns. The constitution of the State of Michigan accords municipalities the right to issue bonds for the development of water-powers, to condemn lands needed for such developments, and to sell the surplus energy so produced wherever a profitable market can be found for it.

The new Sturgis plant will develop 1100 kw from a 22-ft. to 25-ft. fall in the St. Joe River at a point where its flowage varies from extreme floods of 4000 cu. ft. per second down to a minimum of 300 cu. ft. per second. The power house, a concrete structure, 33 ft. x 50 ft., containing two 550-kw vertical-shaft units, will be located at the north shore end of a 300-ft. concrete-arch dam spillway construction of unique design, extended by 1200 ft. of embankment across the flats bordering the riverbed.

The design of the 300-ft. spillway section of the dam is quite unusual, being made up of 15 40-deg. inclined reinforced-concrete arches supported between concrete abutments 20 ft. apart. These arch slabs, presenting their convex surfaces to the upper pond, will make clear spans of 18 ft. each, and are 25 ft. in oblique length. They will be mounted on foundation rings, which add 3 ft. to their effective 17 ft. vertical height, and will be capped by a 2.5-ft. crest slab, which extends the length of the spillway. Viewed in right section, the arch slabs will be 12 in. thick, reinforced by transverse and longitudinal ½-in. round rods, inserted at 18-in. centers, 2 in. within the inner and outer faces. The arches will have a rise of 2 ft. 9 in. The abutments will be of triangular form, with a 45-deg. downstream slope. They are 24 in. thick, 17 ft. 6 in. above the foundations, and have an extreme base of 47 ft. The crest slab, 2 ft. 6 in. thick, is reinforced by ½-in. rods, spaced at 6-in. distances on its under side. At 12-ft. intervals along the crest slab 12-ft. lengths of 80-lb. tee-rail are inserted to serve as standards for the flashboards used to raise the effective height of the dam.

The power house itself will be a concrete building, 50 ft. x 35 ft. The duplicate generating units comprise 844-hp Allis-Chalmers water turbines, driving 550-kw, 2300-volt, 60-cycle, three-phase alternators, mounted on the same vertical shaft. The entire weight of the rotating element is to be carried on a single bearing at the floor level. Another point of novelty is in the so-called "scroll" design of the turbine chambers. By means of this construction the water entering at any of the intake wickets of the turbine is brought in from a tangential movement sweeping around the pit, so that all of the inlet parts receive their water at the same angle, regardless of their position with respect to the gates. The two 550-kw generators are equipped with Allis-Chalmers oil governors. The 40-kw exciter, which is driven by a separate water-wheel, is arranged for hand regulation only. Each unit will be equipped with a separate oil pump and tank, belt-driven from the main shaft. The switchboard will be housed in a compartment just behind the wheel pits, from which it will be divided by bulkheads rising above normal water level. The transformer room is the compartment directly below, and will house two groups of three 200-kw transformers, raising the generated potential of 2300 volts to 23,000 volts for transmission to the city of Sturgis, 20 miles distant, and to other points. Electrolytic lightning arresters will be installed at the generating plant and substations.

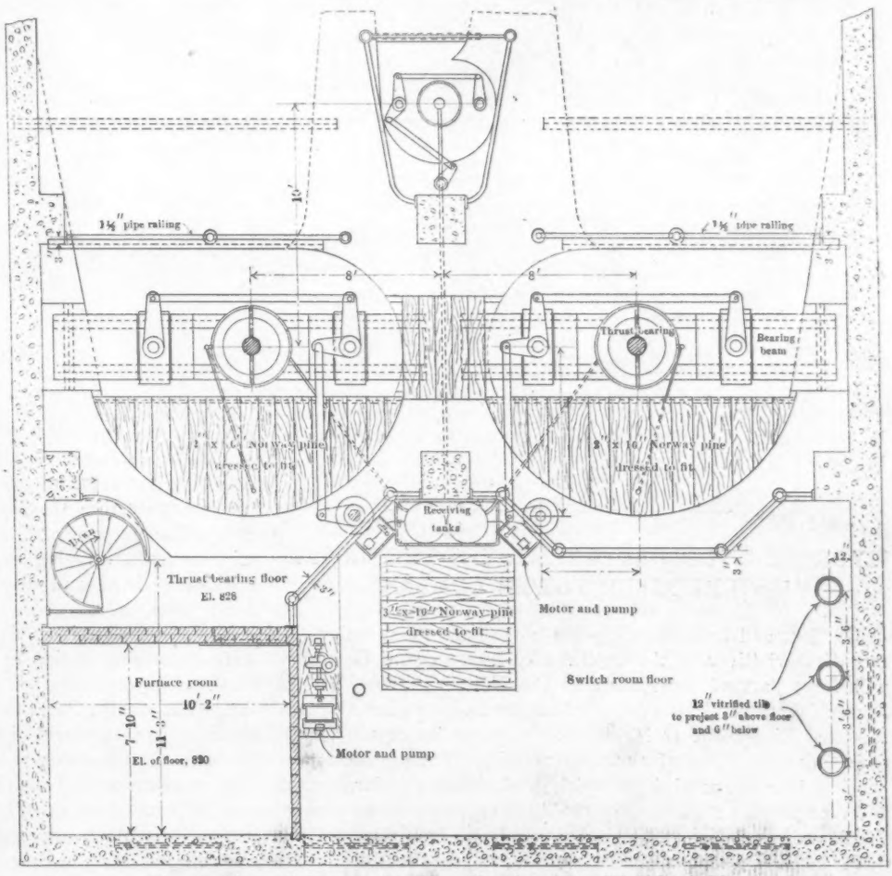


Fig. 2—Plan of Sturgis Station, Showing "Scroll" Wheel Pits.

Besides Sturgis, the towns of Centerville, Meaden and probably other neighboring villages will purchase electrical energy generated at the new station.

Mr. M. E. Aulsbrook is president of the Sturgis town board, which has charge of the undertaking, and Mr. Christian Wilhelm is Mayor of Sturgis. The construction work will be done by the Olson Construction Company. Prof. Gardner S. Williams has acted as consulting engineer and designed the new

development, the total appropriation for which amounts to $175,000. Of this amount, about $40,000 has been expended on real estate. The new station is expected to be in operation by Jan. 15, 1911.

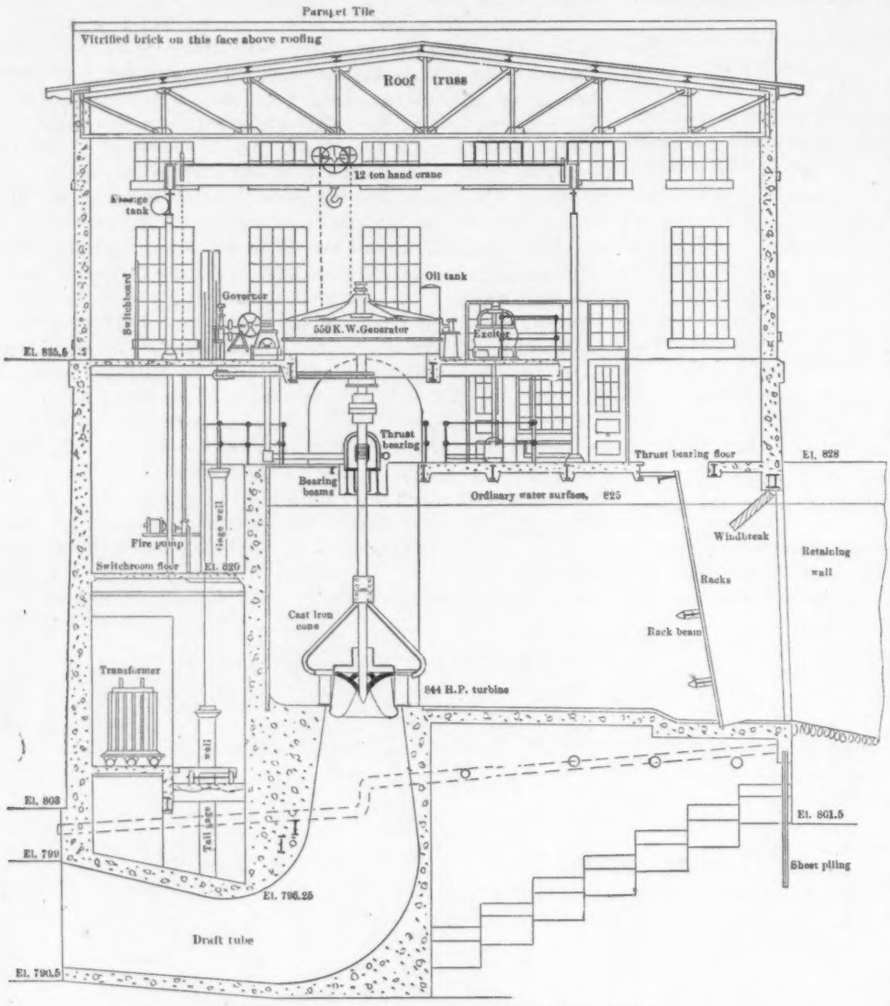


Fig. 3—Elevation of Sturgis Hydroelectric Station.

HYDROELECTRIC DEVELOPMENT OF THE UNITED MISSOURI RIVER POWER COMPANY.

The dam and hydroelectric plant now under construction on the Missouri River by the Capital City Improvement Company will form part of the system of the United Missouri River Power Company. This company has already two plants on the Missouri River; one at Hauserlake of 25,000-hp capacity, and one at Canyon Ferry of 12,000-hp capacity. These powers are developed by means of dams which produce lakes of large area and thus provide storage reservoirs of great value in equalizing the flow of the river. The total available water storage in the three lakes, without appreciably affecting the heads of the plants, will be not less than 150,000 acre-feet, or an amount sufficient to double the flow of the river during the low-water season.

The present plants are used exclusively for the generation of electrical energy for transmission purposes, and the new plant of the Capital City Improvement Company will be used for the same purpose and will be connected to the general system. The electricity is transmitted as three-phase alternating current, at 70,000 volts, to the cities of Helena, Butte and Anaconda and to numerous towns and mining camps in the same territory. The Canyon Ferry plant went into service in 1898, and the Hauserlake plant in 1907. The dam at the latter plant was destroyed some time ago, but the installation will be in operation again about Oct. 1, 1910.

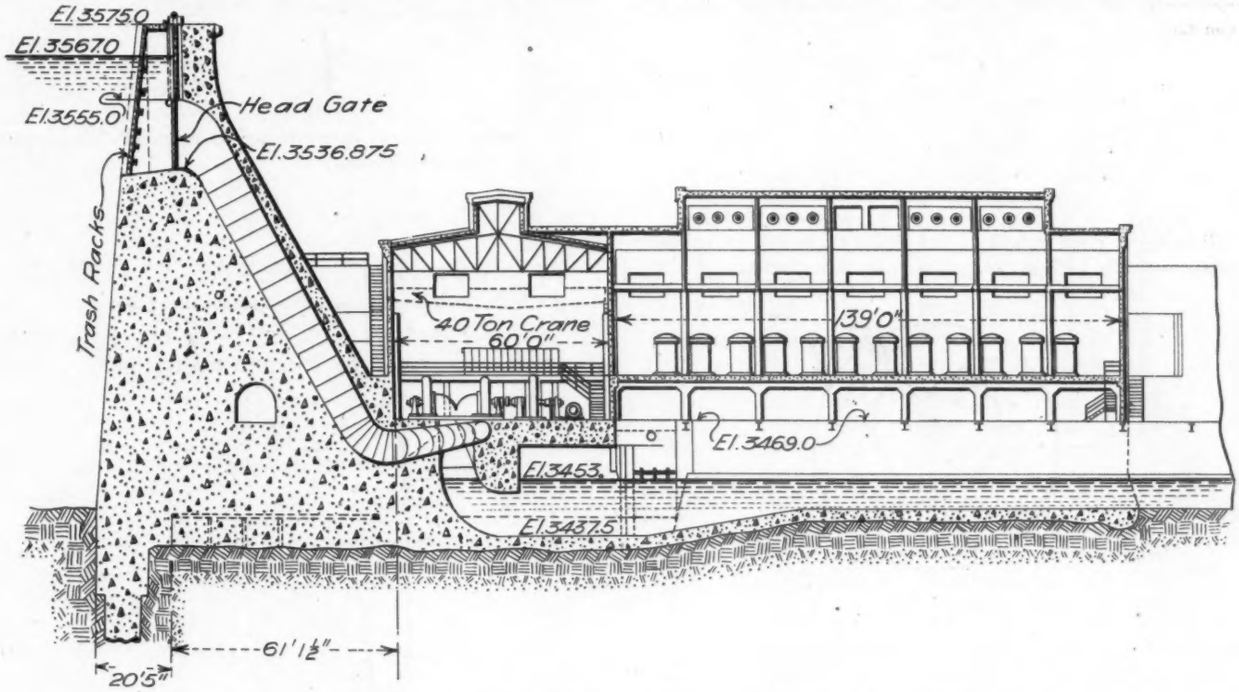
The development now building by the Capital City Improvement Company (a subsidiary corporation of the United Missouri River Power Company) is variously known as Plant No. 3, Wolf Creek Plant, Holter Plant and the Capital City Plant. It is located about 30 miles north of Helena, Mont. The Missouri River at this point passes through a short and narrow canyon with good rock on both sides and at an average depth of not exceeding 10 ft. below low water level. On the right bank the natural rock slopes upwards at an angle of about 20 deg. from the horizontal. On the left bank the rock rises at first quite precipitously, then forms a bench or shelf, and again rises with about the same slope as on the right bank. The width of the main channel, which embraces all that section of the dam where the foundations extend below the present water level, is about 700 ft., but the total length of the dam at the highest elevation is nearly 1400 ft.

The bedrock at the site of the dam is of cretaceous formation, including shales and sandstones with a little limestone and quartzite. The shale is principally red, but there is also some green as well as mottled. This is a massive and practically impervious rock, reasonably hard, and in every way affording a safe foundation for the dam. It is permanent in its nature and not subject to deterioration by solution or otherwise when below the water level. The sandstone is of grayish color, very fine and even grain, and of massive structure. In certain parts it is slaty in appearance and grades off insensibly into the shale; it is perhaps the best rock for foundation purposes. There is also one narrow band of bituminous shale, carrying narrow seams of coal. This rock is reasonably hard and also affords good foundation material for a dam.

The power plant is on the left or west bank of the river. The main generating station is placed parallel with the line of the crest, while the transformer station is at right angles to this line. The dam, power house and hydraulic works will be of concrete masonry, with imbedded rock in the more massive sections. The concrete will be made from river gravel, which is of excellent quality and does not require the addition of either sand or broken stone. The gravel is found in ample quantity in the river bottom near the site. The amount of cement in the concrete will vary in different parts of the work; the surfaces and thin sections having the richest mixtures. The dam will average 130 ft. in height from the foundations to the top of the bulkhead section, and in working condition will sustain an average head of 114 ft. The general features are clearly shown in the engraving.

In addition to the dam section proper, there has been provided on the down-stream side, a submerged apron of concrete 70 ft. in width and of an average thickness of 5 ft. This apron will be built directly on bedrock and will be strengthened by anchor bolting and reinforcing, and will be provided with a suitable

drainage system. The main dam section will be provided with an inspection tunnel and a complete drainage system, as indicated on the plans. There will be about 300,000 yd. of masonry in the entire structure and about 1500 tons of steel. The crest of the dam will be provided with a bridge and flashboard system, designed on lines of standard practice of this company. This arrangement permits of raising the level of the lake to a maximum elevation at the beginning of low-water periods, and also permits the lowering of the lake level during flood conditions to such a point as to provide ample discharge over the crest, and sufficient fall in the canyon between the dams to prevent interference with the plant higher up the river. This flashboard system has been in use in the Canyon Ferry dam for about 12 years, and its efficiency has been thoroughly proven. The arrangement consists essentially of a permanent bridge supported by concrete bents encasing heavy steel reinforcement,



Sectional Elevation of Dam and Generating Station of the Wolf Creek Station.

and of a system of steel stanchions supported by the bridge at their upper end and from the dam at the lower end; these stanchions in turn supporting the flashboards, which are removable planks manipulated either from the bridge or from a floating barge. The flashboards are customarily removed gradually, but provision is made so that in case of necessity the stanchions can be automatically tripped, thus instantly releasing the flashboards and discharging the water for the full height over the crest.

The hydraulic works in connection with the generating plant are designed as part of the main dam structure. There will be seven main hydraulic units and three exciter units; each main unit has its own penstock, which will be imbedded in concrete masonry and provided with a suitable opening at the upper end, this opening being controlled by a massive steel gate provided with Stoney rollers, and operated by means of an electrically driven head-gate machine. Each penstock entrance will be an independent section formed in the concrete and so designed that it can be closed off with a floating gate or with stop logs for the purpose of inspection or repairs of the racks, head gates, guides, etc. The designs provide for the water entering through the trash racks and gates at very low velocity and gradually and uniformly accelerating in the penstock until it reaches the scroll case of the waterwheels, at which point it is moving at the proper velocity for producing the most efficient results.

The waterwheels are under construction by the S. Morgan Smith Company, of York, Pa. Each unit is composed of two runners mounted on a single shaft, each wheel being provided with its individual scroll case and both discharging into a common draft chest placed between the wheels. The governors are of a vertical type and the largest size manufactured by the Lombard Governor Company. They will control the gates through a system of steel links and walking beams. The waterwheel gates will be of forged steel with connections all in one piece. The waterwheel runners will be of government bronze and the main shafts of nickel steel. Each waterwheel unit will develop 8800 hp under full gate opening, and will be direct-connected with a 5000-kw, three-phase, alternating-current generator. The generators will produce current at 6600 volts, which in turn will be transformed to 70,000 volts for transmission purposes. In addition to the main generating units, there will be three exciter units and one auxiliary unit; these machines will be driven by spiral case waterwheels direct-connected with suitable direct-current electrical generators.

The high-tension transformers and apparatus will be located within the fireproof transformer room. All cables will be carried in tunnels and ducts, expressly designed to prevent trouble from short-circuit or from fire. The low-tension switches and busbars will be encased in concrete compartments and will be placed in rooms apart from the high-tension apparatus. All of the electrical equipment is being manufactured by the Westinghouse Electric & Manufacturing Company.

The electrical energy generated at the Wolf Creek station will be combined with that from the Hauserlake and Canyon Ferry stations and will be transmitted over the present lines and system of the United Missouri River Power Company and over additional lines into every city, town and mining camp within many miles of Helena. The lines for the most part are on private right of way and in duplicate. At Butte there is an auxiliary steam station of 6000 hp rating.

The entire development has been planned and the designs prepared by the engineers of the United Missouri River Power Company; Mr. M. H. Gerry, Jr., chief engineer; and Messrs. A. C. Pratt, W. L. Miller, H. Hoyem, Jacob Anthonisen and A. W. Verharen, assistant engineers. The officers of the company are: Mr. S. T. Hauser, president; Mr. B. Y. Frost, vice-president; Mr. W. B. Gower, secretary-treasurer, and Mr. M. H. Gerry, Jr., general manager. The principal office of the company is at Helena, Mont.

CONSTANTS OF CABLES.

The Resistance, Inductance and Capacity of Eccentric Cylinders.

By Mayo Dyer Hersey.

THE usual formulas for the capacity of a cable with eccentric core, and for the other constants of a circuit made up of two circular cylindrical surfaces with parallel but eccentric axes, are too complicated for rapid handling. It is the object of this note to deduce simpler expressions.

If R denote the insulation resistance between the two surfaces, C their electrostatic capacity, and L the self-inductance of the circuit for a high-frequency current, then it can be proved that the three constants are connected by the following general relations, where l is the axial length and ρ, μ, κ denote, respectively, the specific resistance, permeability and dielectric constant:

$$L = \frac{4\pi\mu l^2}{\rho} R \tag{1}$$

$$C = \frac{\kappa\rho}{4\pi}\frac{1}{R} \tag{2}$$

$$L = \mu\kappa l^2 \frac{1}{C} \tag{3}$$

Bearing in mind equations (1) and (2), it will be sufficient mathematically to discuss R alone even when interested physically in L or C; also it may be assumed that $\rho = \mu = \kappa = l = 1$.

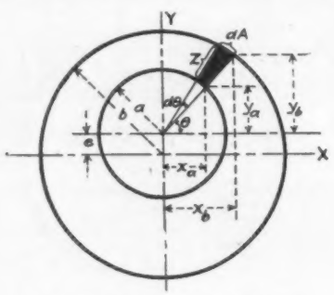


Fig. 1—Eccentric Cylinders.

Now if the inner and outer radii are respectively a and b and the surfaces are concentric, the resistance in c.g.s. units will be

$$R_0 = \frac{1}{2\pi} \cdot \log_\varepsilon \frac{b}{a}, \tag{4}$$

but if there is an eccentricity or displacement of axes e, then the exact formula reduced to its simplest form becomes

$$\left.\begin{aligned} R &= \frac{1}{2\pi}\log_\varepsilon(\beta + \sqrt{\beta^2 - 1}) \\ \text{where} \quad \beta &\equiv \frac{a^2 + b^2 - e^2}{2ab} \end{aligned}\right\} \tag{5}$$

In place of this Russell has proposed the approximate expression*

$$R' = \frac{1}{2\pi}\log_\varepsilon\left(\frac{b}{a} - \frac{b}{a}\frac{e^2}{b^2 - a^2}\right) \tag{6}$$

Finally, the new formula to be presented is the following,

$$R'' = R_0\sqrt{1 - x^2} \tag{7}$$

where x stands for the ratio of eccentricity to difference in radii; and if the ratio of eccentric to concentric resistance be denoted by y, so that

$$x = \frac{e}{b - a} \quad \text{and} \quad y = \frac{R''}{R_0},$$

the relations sought for reduce to the beautifully simple case of the equation to a circle,

$$x^2 + y^2 = 1 \tag{8}$$

Evidently equation (7) is the more useful in analytical and (8) in graphical work, while the new formula is in either case so much more attractive than (5) or (6) as to call for some explanation of its derivation and accuracy.

As an approximation the stream-lines may be assumed to be straight and normal to the inner cylinder. Adding in parallel the elementary resistances of which (Z, dA), in Fig. 1, is typical, the total resistance per unit length is

$$R = \frac{1}{\sum \frac{1}{dR}}, \text{ where } dR = \frac{Z}{dA};$$

or, by introducing the assumption

$$dA = \tfrac{1}{2}(a + b) \cdot d\theta,$$

which is satisfactory when b/a is not too great, an approximate value becomes

$$R''' = \frac{1}{a+b}\frac{1}{\int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \frac{d\theta}{Z}} = \frac{1}{(a+b)\,I} \tag{9}$$

To evaluate I, Z may be expressed in terms of θ by means of the geometrical relations

$$Z + a = \frac{y_b}{\sin\theta}$$

and

$$Z + a = \sqrt{x_b^2 + y_b^2} \text{ or } \sqrt{b^2 - (y_b + e)^2 + y_b^2},$$

from which the elimination of y_b yields the equation

$$Z = \sin\theta\,[\sqrt{e^2 + (b^2 - e^2)\,\csc^2\theta} - e] - a \tag{10}$$

Therefore, neglecting e^2, the integral takes the form

$$I = \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \frac{d\theta}{\sin\theta\,(b\csc\theta - e) - a} \tag{11}$$

which may be rewritten thus

$$I = \frac{1}{e}\int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} \frac{d\theta}{\left(\frac{b-a}{e}\right) - \sin\theta} \tag{12}$$

(12) gives upon integration

$$I = \frac{\pi}{\sqrt{(b-a)^2 - e^2}} \tag{13}$$

When $e = 0$,

$$I_0 = \frac{\pi}{b - a} \tag{14}$$

Now substituting from (13) into (9),

$$R''' = \frac{\sqrt{(b-a)^2 - e^2}}{\pi\,(a+b)} \tag{15}$$

and by substituting from (14) into (9)

$$R_0''' = \frac{1}{\pi}\frac{b-a}{b+a} \tag{16}$$

While both (15) and (16) are simple and useful expressions, a closer degree of approximation is got by dividing the two and writing

$$\frac{R''}{R_0}\left(=\frac{R'''}{R_0'''}\right) = \sqrt{1 - \left(\frac{e}{b-a}\right)^2} \tag{17}$$

which is identical with equations (7) and (8) above.

To sum up for the general case the following formulas may be written:

$$R'' = R_0\sqrt{1 - x^2} \text{ where } R_0 = \frac{\rho}{2\pi l}\log_\varepsilon\frac{b}{a} \tag{18}$$

$$L'' = L_0\sqrt{1 - x^2} \text{ where } L_0 = 2\mu l \log_\varepsilon\frac{b}{a} \tag{19}$$

* Deduced as a capacity formula on p. 104 of Vol. I of "The Theory of Alternating Currents" by Alexander Russell.

$$C'' = \frac{C_0}{\sqrt{1-x^2}} \quad \text{where } C_0 = \frac{\kappa l}{2\log_e \frac{b}{a}} \qquad (20)$$

The usefulness of the formulas in practical work is shown by Fig. 2, a graphical scheme for the calculation of the resistance corresponding to any value of b/a and of x.

Suppose, for example, in two eccentric cylinders the outer radius is 2 in. and the inner radius ¾ in., and eccentricity ¾ in.; then $b/a = 2.67$, $x = 0.6$ and the dotted lines show the course followed by the eye in reading off directly the approximate result $R'' = 0.125$ c.g.s. units when ρ and l are unity. The logarithmic curve DE serves to locate the auxiliary line AB for any value of b/a, and after this only AB and the circular quadrant AC are necessary in solving for any value of x. As an example of the inverse problem, given $a = 1$ in., $b = 3$ in., how great may the eccentricity be without diminishing the resistance by more than 10 per cent of itself? The law of the circle shows at a glance that when $y = 0.9$, $x = 0.43$, consequently $e = 0.86$ in. Capacity and inductance can be just as easily calculated.

Now the accuracy of the several formulas will be examined, denoting by R_0 the concentric resistance (4), and by R, R' and R'' the eccentric resistance according to the exact formula (5), Russell's approximation (6), and the new formula (7), respectively. Let Δ denote the fractional change in resistance due to the displacement e, while Δ' and Δ'' stand for the errors

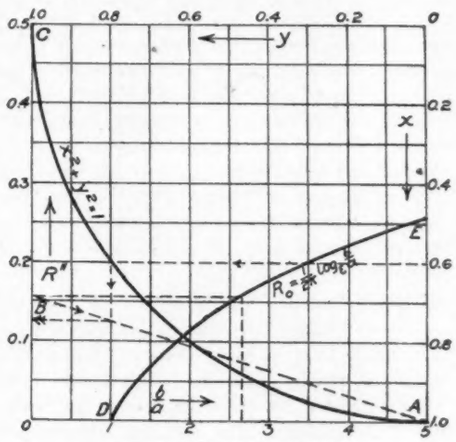


Fig. 2—Calculating Chart.

in R' and R'', respectively. Also let Δ_0 denote the ratio of error of computation to the change due to eccentricity, this relative error being sometimes a more significant criterion than the absolute magnitude. That is,

$$\Delta = \frac{R_0 - R}{R_0}, \quad \Delta' = \frac{R' - R}{R}, \quad \Delta'' = \frac{R'' - R}{R},$$

$$\Delta_0' = \frac{\Delta'}{\Delta}, \text{ and } \Delta_0'' = \frac{\Delta''}{\Delta}.$$

The full curves in Fig. 3 show how the errors Δ' and Δ'' increase with x for several values of b/a, while the dotted curves show the variations of Δ_0' and Δ_0'' for the typical case $b/a = 2$.

The curves in Fig. 4 show how the errors Δ' and Δ'' increase with b/a for several values of x. The shaded area represents a region which can never be crossed by curves of error; the line $x = 1.0$ is the curve of maximum error. There is no corresponding region with Russell's formula. The following facts in favor of the new formula are apparent:

(1) When the outer radius does not exceed three times the inner, the errors of both formulas are negligible for eccentricities less than half the difference in radii.

(2) When x exceeds one-half, the error Δ' rapidly approaches ∞, while Δ'' remains finite and small, even for the maximum eccentricity.

(3) While Δ_0' also approaches ∞, the relative error Δ_0'' diminishes with increasing eccentricity.

(4) As the thickness of insulation decreases, i.e., as b/a approaches unity, Δ' increases, but Δ'' decreases.

(5) Δ' is always + and Δ'' always —; that is, the new formula always yields a result on the safe side, the apparent resistance being slightly less than the true resistance and the apparent capacity greater than the true capacity.

Thus the new formula is to be preferred to Russell's approximation on grounds of accuracy, except in the single case when a large value of b/a combines with a small value of x.

To conclude, there has been developed a system of formulas

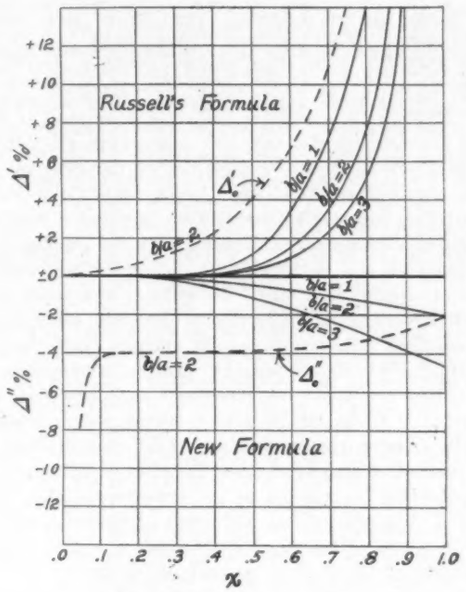


Fig. 3—Correction Factors.

for the constants of eccentric cylinders which can be expressed in three different ways, of which the first is illustrated by equation (8), the second by (15) and (16), and the third by (18), (19) and (20). While the second group is the simplest for

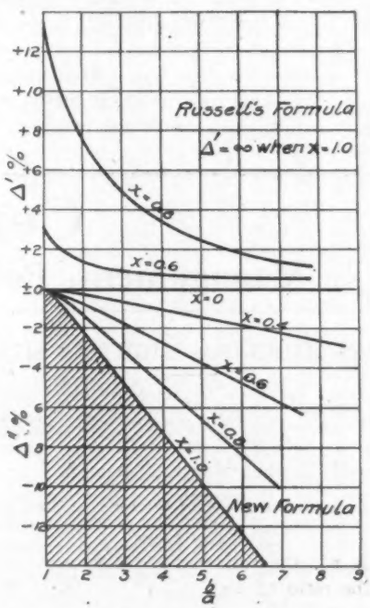


Fig. 4—Correction Factors.

slide-rule work, the first and third are the most generally useful, possessing the following advantages:

(1) Analytical simplicity.

(2) Adaptability for graphical solution.

(3) Explicit relation between eccentric and concentric values.

(4) Accuracy.

In arriving at these results, advantage was taken of whatever relations existed between R, L and C and the ap-

proximations were introduced into the premises as being preferable to remodeling the conclusions. The deduction of approximate formulas in many other cases might be facilitated by a wider application of these two principles.

ESTIMATED COST OF CONDUIT CONSTRUCTION AT SALEM, MASS.

The Salem Electric Lighting Company of Massachusetts is about to undertake the installation of 30,050 ft. of underground conduit including 90 line manholes, 14 transformer manholes and 500 underground connections to buildings, poles, and lamps. The total cost of this work is estimated at $228,097, and the estimate for the company was prepared by Mr. D. A. Harrington, Boston. The company filed the estimate of cost with the Massachusetts Gas and Electric Light Commission at a recent hearing. In the following table is given a transcript of the estimate arranged in accordance with the number of ducts in the conduit and including the manholes required in the lengths of conduit specified. In general the work is to be done in the more populous section of the city. Only such items are transcribed as are of general interest, and the cost of cables, underground connections, service connections, transformers, special distributing poles and lamp posts are not included in the table, which covers simply the estimated cost of typical conduit sections of specified lengths laid in the streets, backfilled and ready for drawing in the mains.

In explaining the figures to the commission, Mr. Harrington stated that each street had been examined and its local conditions noted. It was estimated that the cost of the 30-duct conduit would be 15 or 16 cents per duct foot for each of the 30 ducts for 500 ft., and that the manholes would cost about $250 apiece. Excavation, backfilling and repaving would cost from $1 to $1.50 per cu. yd. The cost depends greatly upon the local conditions. A 12-duct conduit will vary from 20 to 30 cents per foot in different streets, according to the pavement, piping present, tree conditions, etc. Mr. Harrington said that with 4-duct conduit it would be necessary to add perhaps 15 cents per foot on account of different kinds of pavement, whereas the difference in 30-duct conduit would amount to perhaps not over 2 cents per duct foot. The minimum distance from the top of the conduit to the grade of the street is from 18 in. to 30 in. The 18-in. minimum provides for a street with a concrete base under the paving or a concrete track foundation set in the midst of block pavement. The cost of a first-class service pipe laid in a concrete envelope would be about 60 cents per running foot, the street being block-paved.

DETAILED ESTIMATE OF COST OF CONDUIT CONSTRUCTION, SALEM, MASS.

Number of Ducts	Length of Conduit in Feet	Manhole Details in Given Length of Conduit	Estimated Cost, Dollars
4	450	1—4′x5′x5′	800
4	1500	2—4′x5′x5′	2560
4	850	2—4′x5′x5′	1490
4	500	1—4′x5′x5′	880
4	600	2—4′x5′x5′	1090
4	200	2—4′x5′x5′	480
6	800	4—5′x6′x7′	2040
6	900	3—5′x6′x7′	2130
6	1200	3—5′x6′x7′	2730
6	350	1—5′x6′x7′ 1—5′x8′x8′	980
6	300	1—5′x6′x7′	710
6	500	2—5′x6′x7′	1220
6	400	.....	800
6	2000	4—5′x6′x7′	4440
6	700	1—5′x6′x7′	1510
6	700	2—5′x6′x7′	1620
6	800	3—5′x6′x7′	1930
6	500	1—5′x6′x7′	1110
6	450	1—5′x6′x7′	1010
6	400	1—5′x6′x7′	910
6	1200	4—5′x6′x7′	2840
6	700	2—5′x6′x7′	1620
8	600	2—5′x8′x8′	1660
8	500	2—5′x8′x8′	1440
8	650	2—5′x8′x8′	1770
8	900	2—5′x8′x8′	2490
10	250	1—7′x7′x8′	760
12	500	2—5′x8′x8′	1540
12	850	3—5′x8′x8′	2550
14	300	1—6′x8′x8′ 1—4′x4′x4′	1090
14	350	1—5′x8′x8′	1150
16	500	1—7′x7′x7′ 1—6′x8′x8′	1950
22	800	3—6′x8′x8′	3340
22	400	1—8′x8′x8′	1625
30	500	3—8′x8′x8′	2925

The estimate provides for 500 underground connections to buildings, poles and lamps at a cost of $25,000, and the system is planned to reach every building along the line so that future customers can be reached without laying other underground conduit. Transformers are to be located in manholes instead of on poles as heretofore. The building connections will in the main be made from submanholes.

Central Station
Management, Policies and Commercial Methods

PASADENA MUNICIPAL LIGHTING SITUATION.

Mr. William A. Brackenridge, vice-president and manager of the Southern California Edison Company, has made a public statement in which he says that if the truth were known the municipal electric-lighting plant in Pasadena, Cal., is not a paying institution. Mr. Brackenridge says that the recent offer made by his company to light the streets of Pasadena was made in good faith, and should receive the consideration of the voters. This was the second proposal of the company, and it is complained that it was received with scant courtesy. Mr. Brackenridge adds that some time ago, at the request of the Mayor of Pasadena, his company submitted a proposal to buy out the municipal plant and relieve the city of an investment of about $250,000, which is said to be about $75,000 more than the property actually is worth at present. "The Mayor," continues Mr. Brackenridge, "was quite insistent upon the whole cost being paid, and the point was finally conceded to the Mayor upon his assurance that this would bring about a final and complete settlement of the electric-lighting question in Pasadena. As a part of our proposal, we offered to make an agreement with the city as to rates to be charged for electric service, and the rate schedules incorporated in our proposal were made with the knowledge and approval of the Mayor." Mayor Earley, of Pasadena, makes general denial of these charges.

CHEAP ENERGY AT JANESVILLE.

The Janesville Electric Company, of Janesville, Wis., recently inserted a half-page advertisement in one of the Janesville daily papers inviting manufacturers to come to Janesville where, among many other advantages enumerated, is low cost of electric energy. The advertisement shows that the company supplies energy to over 75 per cent of the Janesville manufacturers using electric service, while 17 per cent use steam, 6 per cent combined steam and electricity, and 2 per cent use steam and water-power. A list is then given of 68 Janesville manufacturers using central-station service in this town of 14,000 population.

The Janesville Electric Company, which is under the management of Mr. P. H. Korst, generates a considerable portion of its output with water-power.

HOT-WEATHER ELECTRIC-SERVICE ADVERTISING AT ST. LOUIS.

The Union Electric Light & Power Company, of St. Louis, has been conducting an effective advertising campaign of hot-weather electrical appliances in the English and German daily newspapers of that city. Electric fans for the office and home have been the subject of some well-arranged display "ads," illustrated by line sketches of comfortable offices and kitchens suggestively made so by the fans, on each of which is marked the low cost of operation an hour. Pictures also show how the home laundry is made comfortable by electric washing machines, mangles and flatirons. The Union Company also attaches to some of its outgoing mail a little red sticker combining a diagram of a baseball diamond with a picture of an electric fan, and bearing the appropriate legend: "Fan Time; Put It Home." Other advertisements of the company in the daily papers have illustrated and described large business and manufacturing buildings in St. Louis, where central-station service is used.

AN OIL SINK FOR OIL CANS.

A casual visitor to the sub-basement engine-room of one of the newest office buildings in Chicago will notice against one of the supporting columns near the center of the room what appears to be an ordinary wash-basin or sink, in which the oil-can equipment is kept on a wire basket. The gooseneck over the sink, however, is not connected to the water mains, but leads from the gravity oiling system and can be used to fill the oil cans directly, like drawing water from a faucet. The drain from the sink leads to the oil pump, so that any leakage or oil spilled in filling the cans is caught and returned to the overhead tank. This oil sink thus saves considerable oil otherwise wasted, and keeps the engine-room spotless. The sink is installed in a position where it is convenient to the various machines, and all cans not in use are kept in place on the wire basket where chance drops are drained back into the tank and saved.

THE READING OF METERS BY CUSTOMERS.

A plan which is in force in many central-station organizations is that of leaving a postal card at consumers' premises where the meter reader finds no one at home. This postal card is addressed to the company and has upon it a statement to the effect that the meter reader found no one at home when he called to read the meter and if the consumer will mark the positions of the pointers on the meter dial on the dials printed on the card, his bill will be made out to him as usual. Mr. Frank McMaster, manager of the Beatrice Electric Company, Beatrice, Neb., who tried this plan, stated on the card that this would enable the customer to get the regular discount for prompt payment. He found that this plan is liked by the customers because it tends to convince them that there is no mystery about the reading of meters and that the company certainly must have confidence in its meters if it allows its consumers to read them.

CENTRAL-STATION STORAGE-BATTERY ENGINEER

The Toronto Electric Light Company, Ltd., has appointed from the sales department a storage-battery engineer, who will devote his entire time to exploiting the use of the electric automobile for business and pleasure purposes in Toronto and suburbs. Within the last few months two American concerns have opened garages in Toronto and with the assistance of the local electric-light company a number of sales have been closed. The General Vehicle Company's representative reports selling the O'Keefe Brewery Company two five-ton electric trucks, and states that he has a number of prospective customers who will undoubtedly order trucks in a short time.

The Toronto Electric Light Company offers the services of its expert to all present and prospective owners of electric carriages or business wagons. A rate of 5 cents per kw-hour has been made for current for charging purposes, with lower rates for different classes of business, depending on the amount of current used monthly.

The salesmen at the regular morning meetings have heard addresses on the different makes of batteries from representatives visiting the city and have become familiar with the operation of electric vehicles. The company, to show its progressiveness, has ordered two 500-lb. wagons of different manufactures, and is looking for a great deal of commercial and pleasure electric vehicle charging business.

ELECTRIC STEAM BOILER AND WATER HEATERS AT ESTES PARK, COL.

Beginning June 20, with the second season of the notable "all-electric" hotel of Mr. F. O. Stanley at Estes Park, Col., electricity has been used exclusively for generating the steam used in the laundry, and for supplying the hot water required about the guest-rooms and buildings. As has been already noted in these columns, this hotel derives its electrical energy from a 180-ft. waterfall about four miles distant down the canyon. This water-power site has been developed by the construction of a 200-kw hydroelectric plant which transmits single-phase, 60-cycle energy at 6600 volts to the hotel buildings and the nearby village of 200 persons. Estes Park is 22 miles from the nearest railroad, and is reached only by automobile trucks over a precipitous road. All supplies have to be freighted in this manner, and coal at the park costs $12 a ton. The water-power development and the hotels—a second "manor house" for winter use is now under construction—are properties of Mr. Stanley, an Eastern automobile manufacturer, who is the "discoverer" of Estes Park and has a cottage nearby.

The 85-kw boiler which supplies steam at 60 lb. pressure for the washing machines and mangles in the hotel laundry is capable of evaporating 250 gal. of water an hour. For controlling the heat the electrical equipment of this boiler is divided into four sections, each controlled under separate switches. When starting up with cold water in the boiler, the entire complement of heating units is turned on, and brings the contents up to steam at 60-lb. pressure per square inch in about 40 minutes. After the initial heating only one-half of the electrical heating equipment is required to maintain this pressure under normal operation of the laundry. The boiler is constructed after the fashion of a "porcupine" boiler in which short radial tubes are inserted into the cylindrical shell. Over all the electric boiler measures about 6 ft. in height and 3 ft. in diameter. Inserted in its cylindrical surface are 85 dead-ended tubes, each about 1¼ in. in diameter and 5 in. in length, and containing a 1-kw, 110-volt heating unit. The tubes are arranged in rows, having their outer open ends between the pairs of busbars which encircle the boiler cylinder. The jumpers from the busbars to the binding posts of the heating elements are formed of special zinc link-fuses. As the entire boiler, busbars and all, is enclosed in an outer jacket, ordinary lead fuses would not have been practicable in the high temperature under the jacket. The construction employed affords each heating unit the maximum surface contact with the boiler contents, and provides separate fusing for each heating element. This electric steam boiler was constructed especially for the Estes Park Hotel by the General Electric Company, and is doubtless the largest similar apparatus ever built.

Besides the steam boiler in the laundry, there are four heaters in use for supplying hot water to the hotel buildings and the laundry. A 600-gal. tank in the main summer-hotel basement provides hot water for the guests' baths, lavatories, etc., and

has also pipe connections to small hot-water radiators in the private bathrooms, intended for emergency use on chilly mornings during the hotel season. Another heating tank, of 200 gal. capacity, is in use in the kitchen, furnishing all hot water for washing and cleaning purposes. A 200-gal. tank in the laundry supplies all the needs of that place, in conjunction with the steam boiler, besides furnishing hot water for the employees' quarters, which are above. In the new "manor house" now under construction, which is smaller than the main summer building, and will remain open throughout the year, a 400-gal. heater tank will be installed for furnishing the hot water for baths and lavatories. Each of the four electric heating tanks above mentioned is equipped with 20 kw in heating units. The tanks themselves are 8-in. pipes, in which the small dead-ended tubes containing the heating elements are ranged in two parallel rows throughout the length of the pipe. Three busbars run the length of the two rows of tubes, one row of which being connected between each pair of bars. In this way three heats are obtainable by interchanging connections, throwing in the two rows in series, one row at a time, or both rows in multiple across 110 volts.

Mr. Stanley, who has taken a lively interest in the use of electrical devices in his hotel, is very much pleased with electric water heating on a large scale after two months' trial. He says: "The steam boiler and hot-water heaters are an entire success, and the problem of hot-water supply has been completely solved. Twenty kilowatts for the 600-gal. tank has proved ample. The laundry is delightfully cool, and the temperature at the outside of the jacket of the steam boiler does not rise above blood heat, in spite of carrying 60 lb. pressure inside."

Electric heat is now under consideration for the manor house, which will be open during the coming winter.

ORGANIZATION OF MUNICIPAL DEPARTMENT OF ELECTRICITY IN CHICAGO.

The accompanying chart, showing the actual organization of the Department of Electricity of the city of Chicago, will be inspected with considerable interest. The work is classified as follows: (1) Electric street-lighting service; (2) fire-alarm, police and other municipal telephone and telegraph systems; (3) electrical construction, maintenance and renewals; (4) bureau of electrical inspection; (5) gas and gasoline lamp and meter service; (6) examiner of moving-picture operators; (7) office clerical force, and (8) the personal stenographer of the head of the department. All these bureaus and individuals report to the city electrician.

The gas and gasoline lamp and meter service has to do principally with street lighting by gas lamps, although provision is also made for testing gas meters of individual consumers, where an official complaint is lodged with the department. The examination of moving-picture operators is a comparatively late addition to the department, and is no doubt assigned to the Department of Electricity owing to the conspicuous and almost indispensable use made of electric lighting in the particular form required by the moving-picture theaters. The greatest number of classified positions is in the bureau of electrical construction, maintenance and renewals, while the electric street-lighting service and the bureau of electrical inspection are both important sub-departments. The duties of the former will be greatly extended, no doubt, when the contemplated addition of 10,000 street arc lamps, supplied by the Sanitary District, is in operation.

The chart given herewith was made by the Civil Service Commission of Chicago (of which Mr. Elton Lower is president) in co-operation with the Municipal Efficiency Commission. Similar charts are made for all the other departments of the city government, and they show the organization, with the lines of authority, the working forces and salaries or wage scale. Acting with the Efficiency Commission, the civil service administration is putting into effect an efficiency plan—that is, a system for maintaining the efficiency of employees, in addition to filling the municipal positions on merit by competitive examinations. In general, the efficiency plan may be described as an effort to adapt to municipal service the conditions of efficiency and cost-figuring in operation in many large business corporations. It has for its object the organization of an administrative and expert staff, charged with the duty of ascertaining what results each group, bureau and department of the municipal service is obtaining from men and money allotted to it. The plan also contemplates determining and recording the success or failure of individual appointees in performing their duties, either personally or in handling subordinates. Before adopting it, it became necessary to make a thorough classi-

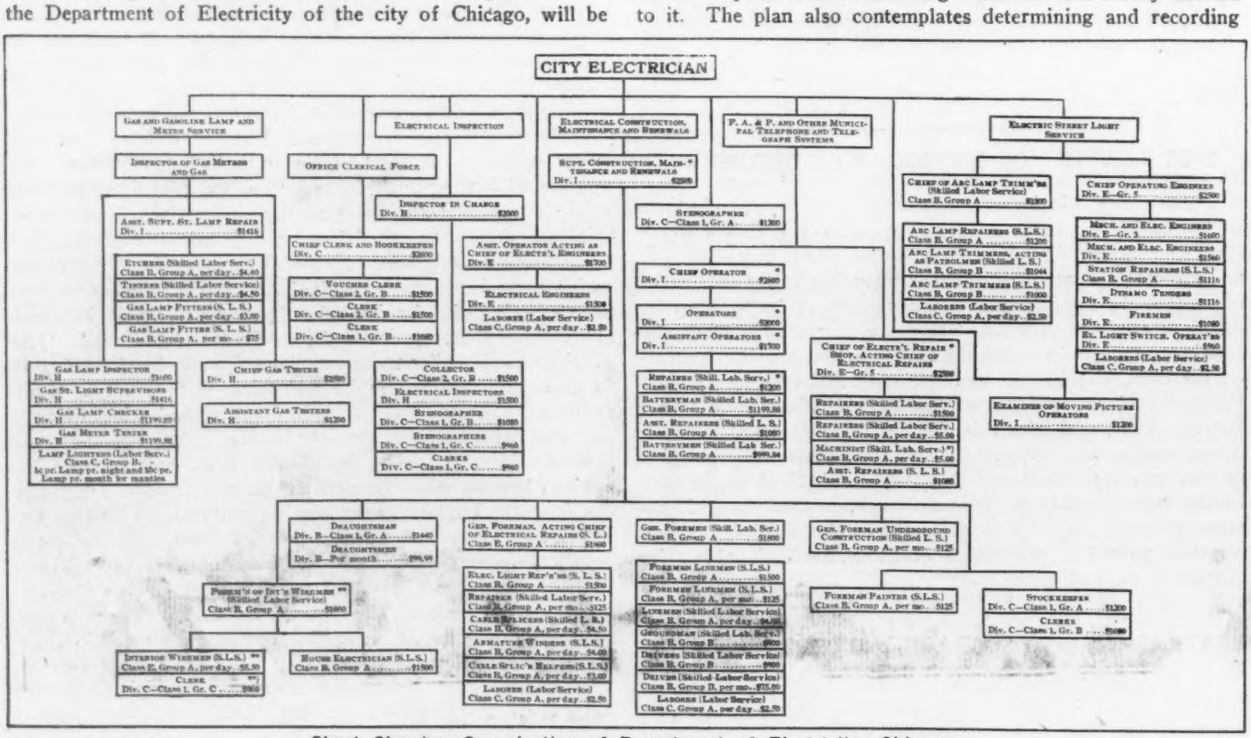

CITY ELECTRICIAN
Gas and Gasoline Lamp and Meter Service
Inspector of Gas Meters and Gas
Asst. Supt. St. Lamp Repair Div. I $1416
Etchers (Skilled Labor Serv.) Class B, Group A, per day .. $4.40
Tinners (Skilled Labor Service) Class B, Group A, per day .. $4.50
Gas Lamp Fitters (S. L. S.) Class B, Group A, per day .. $3.60
Gas Lamp Fitter (S. L. S.) Class B, Group A, per mo ... $75
Gas Lamp Inspector Div. H $1600
Gas St. Light Supervisors Div. H $1416
Gas Lamp Checker Div. H $1190.88
Gas Meter Tester Div. H $1190.88
Lamp Lighters (Labor Serv.) Class C, Group B. 1c pr. Lamp pr. night and 10c pr. Lamp pr. month for manties
Chief Gas Tester Div. H $2280
Assistant Gas Testers Div. H $1200
Electrical Inspection
Office Clerical Force
Inspector in Charge Div. H $2000
Chief Clerk and Bookkeeper Div. C $2000
Vouchr Clerk Div. C—Class 2, Gr. B $1500
Clerk Div. C—Class 2, Gr. B $1200
Clerk Div. C—Class 1, Gr. B $1080
Asst. Operator Acting as Chief of Elctr'l. Engineers Div. E $1700
Electrical Engineers Div. E $1320
Laborer (Labor Service) Class C, Group A, per day .. $2.20
Collector Div. C—Class 2, Gr. B $1500
Electrical Inspectors Div. H $1200
Stenographer Div. C—Class 1, Gr. B $1080
Stenographers Div. C—Class 1, Gr. C $960
Clerks Div. C—Class 1, Gr. C $960
Electrical Construction, Maintenance and Renewals
Supt. Construction, Maint'ce and Renewals Div. I $2880
F. A. & P. and Other Municipal Telephone and Telegraph Systems
Stenographer Div. C—Class 1, Gr. A $1200
Chief Operator Div. I $2600
Operators Div. I $2000
Assistant Operators Div. I $1700
Repairers (Skill. Lab. Serv.) Class B, Group A $1200
Batterymen (Skilled Lab. Ser.) Class B, Group A $1190.88
Asst. Repairers (Skilled L. S.) Class B, Group A $1080
Batterymen (Skilled Lab. Ser.) Class B, Group A $990.84
Electric Street Light Service
Chief of Arc Lamp Trimm'rs (Skilled Labor Service) Class B, Group A $1200
Arc Lamp Repairers (S.L.S.) Class B, Group A $1200
Arc Lamp Trimmers, acting as Patrolmen (Skilled L. S.) Class B, Group B $1044
Arc Lamp Trimmers (S.L.S.) Class B, Group B $1000
Laborers (Labor Service) Class C, Group A, per day .. $2.20
Chief Operating Engineer Div. E—Gr. 5 ..... $2500
Mech. and Elec. Engineer Div. E—Gr. 3 ..... $1600
Mech. and Elec. Engineers Div. E $1560
Station Repairers (S.L.S.) Class B, Group A $1116
Dynamo Tenders Div. E $1116
Firemen Div. E $1080
El. Light Switch. Operat'rs Div. E $960
Laborers (Labor Service) Class C, Group A, per day .. $2.20
Chief of Elctr'l. Repair Shop, Acting Chief of Electrical Repairs Div. E—Gr. 5 ..... $2500
Repairers (Skilled Labor Serv.) Class B, Group A $1200
Repairers (Skilled Labor Serv.) Class B, Group A, per day .. $5.00
Machinist (Skill. Lab. Serv.) Class B, Group A, per day .. $5.00
Asst. Repairers (S. L. S.) Class B, Group A $1080
Examiner of Moving Picture Operators Div. I $1200
Draughtsman Div. B—Class 1, Gr. A $1440
Draughtsmen Div. B—Per month $99.99
Forem'n of Dist'n Wiremen (Skilled Labor Service) Class B, Group A $1000
Interior Wiremen (S.L.S.) Class E, Group A, per day .. $5.50
Clerk Div. C—Class 1, Gr. C $960
House Electrician (S.L.S.) Class B, Group A $1200
Gen. Foreman, Acting Chief of Electrical Repairs (S. L.) Class E, Group A $1860
Elec. Light Repr'm'n (S. L. S.) Class B, Group A $1200
Repairer (Skilled Labor Serv.) Class B, Group A, per mo ... $125
Cable Splicers (Skilled L. S.) Class B, Group A, per day .. $4.80
Armature Winders (S.L.S.) Class B, Group A, per day .. $4.00
Cable Splic'n Helpers (S.L.S.) Class B, Group A, per day .. $3.00
Laborer (Labor Service) Class C, Group A, per day .. $2.20
Gen. Foreman (Skill. Lab. Ser.) Class B, Group A $1400
Foreman Linemen (S.L.S.) Class B, Group A $1500
Foreman Linemen (S.L.S.) Class B, Group A, per mo ... $125
Linemen (Skilled Labor Service) Class B, Group A, per day .. $4.80
Groundman (Skilled Lab. Serv.) Class B, Group B $900
Drivers (Skilled Labor Service) Class B, Group B $900
Drivers (Skilled Labor Service) Class B, Group B, per mo .. $75.00
Laborer (Labor Service) Class C, Group A, per day .. $2.20
Gen. Foreman Underground Construction (Skilled L. S.) Class B, Group A, per mo ... $125
Foreman Painter (S.L.S.) Class B, Group A, per mo ... $125
Stockkeeper Div. C—Class 1, Gr. A $1200
Clerks Div. C—Class 1, Gr. B $1080

Chart Showing Organization of Department of Electricity, Chicago.

fication and study of the duties of the entire municipal service, including approximately 15,000 employees. The chart made of the Department of Electricity in carrying out this classification is the one presented herewith.

Wiring and Illumination

LOW-VOLTAGE TUNGSTEN LIGHTING IN THEATER

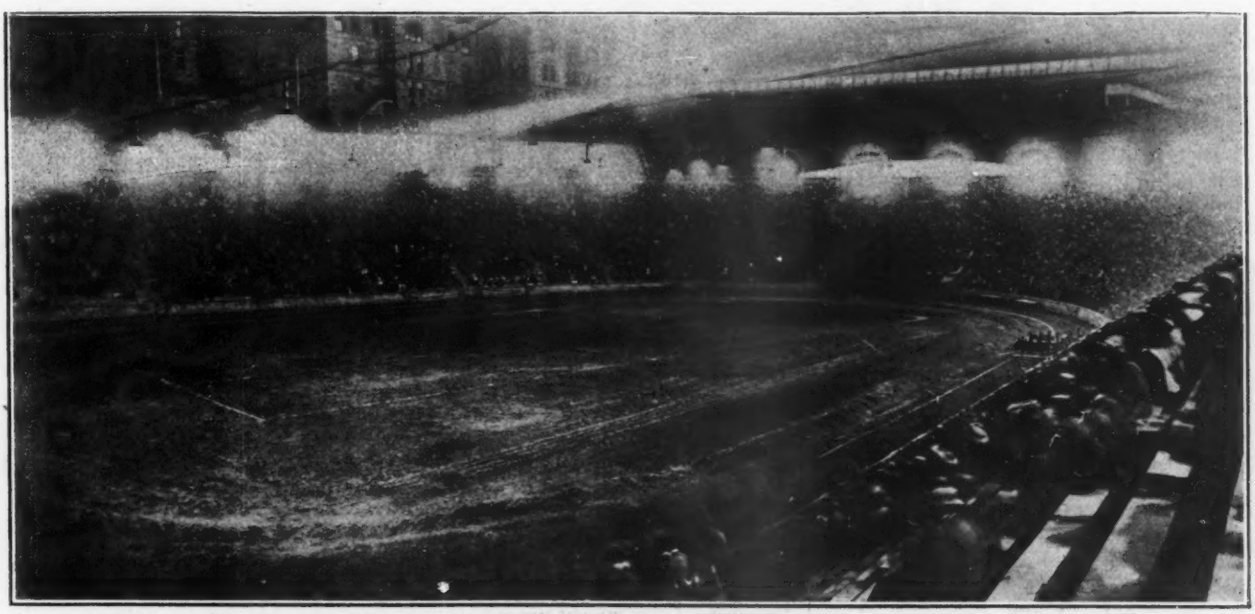
In the new Crystal Theater in Milwaukee, a handsome little vaudeville playhouse seating about 1000 persons, the auditorium is lighted throughout by low-voltage tungsten lamps, with the exception of a few indirect-lighting units in the center of the house. The interior is lighted by about 1800 20-cp, 27-volt, tungsten lamps of the new wire-joint type, energized from nine 220-to-27-volt auto-transformers. In addition to these lamps, which are principally decorative in arrangement, there are eight indirect-lighting units each containing four 100-watt, 110-volt, tungsten lamps. All of the stage lighting is done by carbon lamps, as it was feared that the dimming equipment required for the low-voltage tungsten lamps would complicate operation and require special apparatus. Outside of the theater is a large sign containing 1000 4-cp, 5-watt, 10-volt tungsten lamps connected in multiple-series, without the use of transformers. The lighting of the Modjeska Theater in Milwaukee, where only moving pictures are shown, has recently been converted from 110-volt carbon to 27-volt tungsten, with a large consequent saving in the energy required. These theaters are two of a chain of six owned by the Sachs Company, in all of which low-voltage tungsten lighting will be installed.

ILLUMINATION OF THE TACOMA STADIUM.

A practical illustration of the use of flaming-arc lamps for illuminating large areas is found in the Stadium, at Tacoma, Wash., which is said to be the largest in the world. It covers an area of five acres.

For illuminating this area use is made of five rows of flaming-arc lamps parallel to the bay end of the stadium. On the outer row there are six lamps; on the next, four; the third, six; the fourth, four; and the fifth, three, making a total of 23 immediately over the arena. At either end of the abutment and above each of the 28 gates leading to the seat tiers is a 3000-cp lamp, the rating of lamps directly above the field being 3500 cp. The lamps around the stadium are not shaded, but shading reflectors are used on those directly above the field. The arrangement is such that a spectator may sit anywhere in the stadium without receiving rays in his eyes directly from any lamp. Excellent diffusion of illumination is obtained, and the effect produced by the soft, mellow light is quite pleasing. The illumination density is such that a cavalryman can pick up objects from the ground as readily at night as in the daytime.

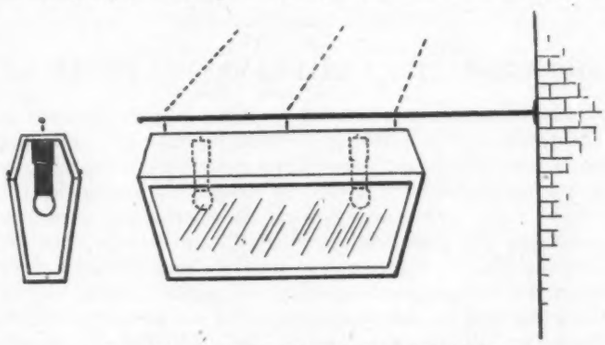
The lamps are of the Grant type, each consuming about 550 watts. They were furnished by Parrott & Company, San Francisco, Cal.



Illumination of Tacoma Stadium.

ILLUMINATED SIGN USING FLAMING-ARC LAMPS.

The accompanying sketch shows an arrangement of a flaming-arc illuminated sign, suggested by Mr. C. M. Axford, Chicago, in which a pair of lamps are used to illuminate the letters, and at the same time to light the sidewalk and store front where the sign is installed. The proposed construction is made clear by the sketch. The two flaming-arc lamps are connected in series across 110 volts, and together consume about 1 kw. The signs should be black letters on a frosted background, or vice versa, and the sign surfaces should be inclined about 10 deg. to the vertical so as to be most effectively read along the street. Above the sign spaces are hinged doors, through which access can be had to the lamps for renewals. These doors should be



Sign Illuminated with Flaming Arc Lamps.

provided with gutters discharging at the curb line. The street end of the box should be closed, or may be used for a small sign, while the end toward the building should be left open and preferably cut away as shown, to allow light from the lamps to reach the windows and store front. For this purpose, the sign, which should be about 10 ft. in length, extending to the curb, should be mounted at least 4 ft. away from the building line, being suspended from a chain and bracket or other construction. Opal globes on the flaming-arc lamps will tend to improve diffusion of the light within the sign, and minimize "spotting" of the letters. The use of an illuminated sign of this kind is suggested in positions where it has been the custom to hang a pair of naked flaming-arc lamps in front of a store, depending on them to light the front and windows and the owner's sign. Under such conditions the extreme intensity of the lamps defeats the latter purpose, causing passers-by rather to instinctively shield their eyes from the glare. The sign proposed would, on the other hand, show the proprietor's legend to advantage along the entire street, besides lighting his sidewalk and windows, all at minimum electrical expenditure.

STORAGE-BATTERY EXIT LAMPS FOR THEATERS.

Mr. Samuel Lederer, manager of the Olympic Theater in Chicago, has been in Berlin inspecting systems of theater-exit lighting by electric lamps energized from storage batteries, an arrangement which eliminates all danger of interruption of outside supply sources, and marks an improvement over the gas flames that have been used in Chicago houses since the Iroquois fire. It is proposed to install a local storage battery of several cells to furnish energy for each exit lamp, making the equipment at each exit complete in itself. As a further precaution against outage, due to broken filaments, each exit sign will be provided with two lamps, the second of which is automatically switched on if the first lamp goes out from any cause. By connecting all the exit-lamp circuits in series by a tie-wire, the batteries can be charged from the regular source of energy during normal operation, while any interruption to the supply leaves each lamp fed by its individual battery. The use of gas for exit signs has been open to the objections of freezing during winter, blowing out when exit doors are opened, and the danger of having matches, gas and open flames about a theater building. The Chicago ordinance permits either gas or electrically lighted exit signs, but at present the majority of the larger theaters have gas installations on account of what is believed to be their greater reliability against possible interruption.

NEW TELEPHONE PATENTS.

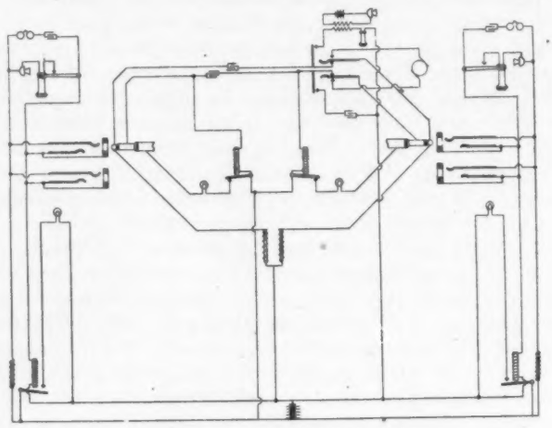
NEW TRANSMITTERS.

A departure in transmitters is described in patents granted to Mr. C. L. Chisholm, of New Brunswick, Canada. In this transmitter the diaphragm is reduced in size until its diameter is substantially that of the usual microphonic button. It is stated that the fundamental period of vibration of such a diaphragm is far higher than the highest tones of the voice and therefore no damping is required. The peripheral seat for the diaphragm should be as small as possible and there should be no initial strains. Thus the seat is reduced to a sixty-fourth of an inch and the diaphragm soldered or cemented in. The back of the microphone button is an auxiliary diaphragm carrying the back electrode at its middle. The electrode is rigidly mounted, but the button casing is free to move within the limits of flexure of the rear diaphragm.

EXCHANGE SYSTEMS.

A very inexpensive exchange system has been devised and patented by Mr. E. C. Rodman, of West Point, Ia. The cord pairs normally have no connection to the common battery and a cheap form of signal is used. An ordinary drop serves as a line signal, being released when the circuit is closed at its corresponding station. In answering the operator cuts off the drop through jack contacts. When a connection is completed, one pole of the battery is connected to one side of each of the two lines, and thence back through the instruments and jacks to the top side of the cord circuit. The other pole of the battery is connected through the jacks to the second strand of the cord circuit. A single magnetic signal is connected between the two-cord strands and this serves as an isolating retardation coil. This signal is displayed as long as either party holds the receiver off the switch hook.

The illustration shows a diagram of the system of common-battery working patented by Mr. C. L. Goodrun, of Atlantic City. It will be seen that when a plug is in the jack of a line the line relay becomes shunted out by the battery feed retarda-



Goodrum Common-Battery System.

tion coil of the cord circuit. At the same time the supervisory lamp finds a path back to battery, its circuit turning back through the strapped contacts in the jack and thence through the dip cord strand and the cord retardation coil.

An automatic exchange system is the subject of a patent granted to Mr. A. E. Stevens, of Fall River, Mass. This is designed especially for use in small centers of population where there are, in addition to the usual exchange lines, multi-party, rural or farmer lines. The apparatus and manipulations are of the types general for automatic systems, but the system is especially arranged so that the stations of a line may intercommunicate without involving the switching apparatus, yet while in use are barred to an incoming call from the exchange. Again, they can at will call through the exchange. The system also provides for either common or local-battery talking sets.

PARTY LINE DEVICES.

A rather complete lockout party line system has been invented and patented by Mr. H. J. Roberts, who has assigned his patent to the Homer Roberts Telephone Company. One side of the party line is continuous from end to end. The other is in sections from station to station. At each station the incoming section is connected through the bell to the continuous side of the line. Thus, if a signal be sent out from central it will ring the first station bell. To skip the first station it is necessary to build the line to the second station. This is done by sending out an impulse of current, which cuts out the first station and connects on the line section extending to the second section.

For an incoming call, a signal is set over the continuous side of the line. The operator upon responding pulls a key which sends out in rapid succession a considerable number of impulses and thus she rapidly builds up the broken side of the line to the calling station at which the apparatus is so set as to stop the effect of further impulses of that polarity. Arrangement is also made for clearing out the circuit after a connection and for supervision. It is also possible for a locked out station to set the line so that his calling signal will come in as soon as the line is free. Mr. W. E. Zabst, of Portage, Wis., has also patented a party line apparatus. This includes a bar for

obstructing the motion of the bell clapper and a mechanism for elevating the bar.

Normally the bell comes to rest in such a position as to engage a barb upon the bar and prevent its elevation normally. Upon the arrival of properly poled impulses of current, the bell rod is thrown clear of the barb and at the same time the bar is elevated one step. Each bar has a notch which comes opposite to the bell and thus releases it at the elevation corresponding to its station. After conversation all bars are advanced to their uppermost positions when they fall back to zero.

The patent issued to Mr. L. W. Carroll, of Anamosa, Ia., relates to a harmonic system of signaling. Vibrating reeds, linked to transmitters, send out currents of predetermined frequencies, and the various stations have tuned receiving devices to correspond. These vibrate before resonators and give the audible signal.

The plan of signaling selectively, proposed by Mr. O. T. Lademan, of Milwaukee, requires a double-wound differential relay at each station. The windings of the relay are included in the respective sides of the line so that their action in retarding talking currents is confined to the ohmic resistance. To signal, current is sent out on both sides of the line in parallel and thence to ground through a connection made between coils at the line extremity.

The invention of Mr. A. H. Dyson, of Chicago, relates to a recording system for party-lines operated in connection with an automatic system. For certain classes of calls it is necessary to know not only the line number, but the station number originating the call. In the automatic system contemplated one side of the line is used in sending stepping impulses, while the other side serves to effect the shift from one digit mechanism to the next. Mr. Dyson codifies the shifting impulses so that not only is the required shift made, but also his register is affected to set a type wheel and print the station number. Thus, one impulse on the shift line may be station one, two station two, etc. The Kellogg Switchboard & Supply Company has obtained this patent by assignment.

IMPROVEMENTS IN MANUAL SWITCHBOARDS.

A circuit system for a manual common-battery switchboard forms the subject of a patent issued to Mr. S. B. Fowler, of Lafayette, Ind. In this system a special combined line and cut-off relay is used. The line coil is double wound and serves as a battery feed retardation coil. Two armatures are arranged before it. One of these is a long armature pivoted at its middle, and its other end is exposed to action of the cut-off relay winding. When a call arrives both armatures respond to the line winding. The long one lights the line lamp and the short one removes a short-circuit from the cut-off relay winding. When the operator inserts a plug the cut-off winding restores the long armature to normal through its counter pull. There is no effect upon the short armature and the supervisory relay lamp in the cord strand circuit does not glow as the cut-off relay is of too high resistance. If, however, the line relay be de-energized, permitting the short armature to fall and restore the shunt upon the cut-off relay, the cord lamp will glow.

Mr. A. D. T. Libby, of Elyria, Ohio, has arranged a cord circuit with a three-strand cord and two-part plug. Two-cord strands connect to the plug shank. One of these carries talking currents exclusively and the other carries only battery currents for signal operation. This patent has been assigned to the Dean Electric Company.

LETTERS TO THE EDITOR.

Transmission Line Calculations.

To the Editor of Electrical World:

SIR:—I have read with much interest the article by Mr. J. F. H. Douglas in your issue, April 28, 1910, page 1066, on the application of certain developments in series to a very simple and practical method for the calculation of alternating-current transmission lines. I beg, however, to be allowed to point out that a similar employment of series, together with numerous practical applications under a form somewhat different, but in essence identical, by M. C. Le Roy and the writer, appeared in *La Lumière Electrique* in the issues of 1909 numbered 38, 39, 43, 44 and 52. Referring notably to the formulas on page 360, it will be seen that the only difference is that Mr. Douglas represents the vectors by letters accompanied with a dot underneath, while we indicated the vectors by a horizontal line above, with an indication alongside of the angle of rotation of the vector. Our notation appears to be the clearer and more apt to obviate error. The method of Mr. Douglas is the more rapid, but it does not show the convergence and the degree of approximation so well as the geometrical method we employed. We believe that a comparison of the two articles will show that priority for the method should be assigned to M. Le Roy and the writer.

Paris, France. ANDRE BLONDEL.

[The belated appearance of Prof. Blondel's letter, which is dated June 6, is due to the communication not having been properly delivered upon its receipt in New York.—ED.]

Protection of Iron by Galvanizing.

To the Editor of Electrical World:

SIR:—During the demolition of the Gillinder Building, at the northwest corner of Wall and Nassau streets, New York, I have had opportunity to observe the condition of the electrical installation installed 12 years ago. One or two features of its condition at the time of demolition deserve notice.

The conduit used was "lined" standard-weight iron pipe, enameled on the outside. Wherever this conduit had come in contact with cinder concrete fill it showed considerable flake rusting and pitting, although the corrosion had not advanced sufficiently to injure the pipe seriously. The enameling or outside treatment had entirely disappeared. Had the conduit been made of thin wall pipe the corrosion might have been considered a serious matter.

Wherever the conduit was encased in cement or built into chases the enameling had almost entirely gone, but the rusting was merely a surface skin and could be almost wiped off with a piece of cloth, thus showing that it was not progressive. In general, all threads well leaded in couplings were clean and bright. In many cases the lining of the conduit had flaked off, cracked, or had coagulated into the form of irregularly-shaped beads adhering to the wire and to the inside of the pipe. This condition existed generally wherever the conduit was laid near steam pipes, even at some distance from them, and wherever the conduit was exposed to heated air.

The rubber-covered conductors showed a remarkable state of preservation, due largely to the fact that the insulating compound contained the proper amount of fine para gum (30 per cent), and was protected with fine quality braids well impregnated. The compound as it exists to-day exhibits the physical characteristics of a new high-grade code insulation containing, say, from 15 per cent to 20 per cent of inferior rubber. There was no sign of cracking, hardening or disintegration, even where the conduits had been exposed to a moderate heat and where the conduit lining was in bad shape.

This is particularly interesting since in samples of rubber-covered code wire, taken by the writer from another building of about the same age and now under reconstruction, the insulating compound was largely disintegrated. This wire had been pulled in circular loom, but was installed in a perfectly dry frame construction.

The lesson I draw from a study of the Gillinder Building installation has to do with the conduit and its rust protection. Comparisons may be drawn in this same building with the rust protection of pipes used for other purposes, and it may as well be stated at once that the only pipe in contact with cinder fill that had not rusted was the hot-dip galvanized plumbers' pipe. All black-iron pipe not in chases had badly disintegrated.

The writer has observed much rusting of conduit and outlet boxes even where not in contact with cinders, due largely to the

high speed and often slovenly methods of modern building construction. He has particularly in mind one installation where the building was wet even after the white-coat plaster had been placed on the lower floors; concrete and mortar mixing was in progress on the upper floors, thereby causing a constant seepage of water from the top to the bottom of the building. In this installation electro-galvanized conduit and boxes were used, while all floor boxes were hot-dip galvanized. The electro-galvanized conduit and boxes exposed to the acid-charged water were badly rusted before the work was half completed. The hot-dipped material showed no signs of corrosion except in one or two cases of defective galvanizing.

This hot-dipped material seemed to be protected by a coating of insoluble zinc oxide that had formed over the zinc. Recent tests lead to the belief that no conduit now on the market, enamel or otherwise, as it is usually installed, is free from this defect of corrosion.

The writer hopes that this matter will receive discussion, for most of the conduit manufacturers have recently installed expensive electro-galvanizing or sherardizing plants, which would prove a loss should it be finally shown that the old-fashioned marine hot-dip process or some other process where thorough amalgamation of the two metals occur is the best.

New York. Bassett Jones, Jr.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Testing of Transformer Regulation.—C. V. Drysdale.—Where transformers are run in parallel it is important that all of the transformers should have similar regulation curves. For inductive loads the curves are not similar, unless the ratio and phase displacement are the same for each transformer at the same fraction of full load. The usual short-circuit test is not very suitable for obtaining these data, as the instruments are generally working at the bottom of their range, and a small error in the indications makes a large error in the final result. The author, therefore, proposes a method in which the voltage of the transformer under test is compared with that of a second transformer of approximately the same ratio on open circuit. For the measurement of the difference of the voltages, use is made of a wattmeter in which the moving coil is connected to the constant voltage of the auxiliary transformer, while the main coils, in series with a non-inductive resistance, are used as a low-resistance voltmeter. In order to measure the reactance or phase displacement with greater accuracy, a condenser can be inserted in the shunt circuit. The connections for the test are shown in Fig. 1, in which the transformer under

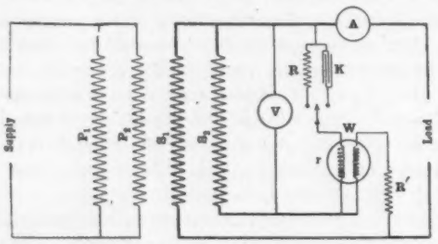
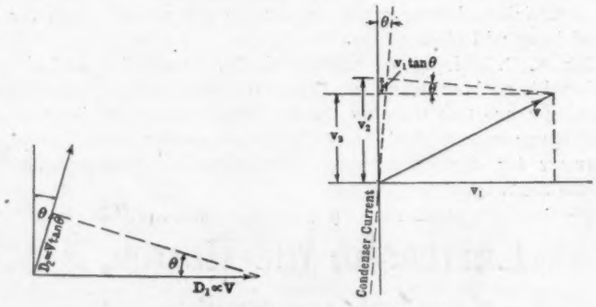


Fig. 1—Diagram of Connections for Test.

test P_1S_1 is shown connected to the supply mains and to a load exactly as in service, and in parallel with an auxiliary transformer P_2S_2 of approximately the same ratio. If the secondary circuits of the transformers S_1 and S_2 are connected as shown, the potential difference between the two lower conductors will be the vector difference between the voltage of the auxiliary and test transformer. The main coil of the wattmeter W is connected between these two lower leads with a non-inductive resistance R' in series with it, while the moving coil circuit is connected to the secondary of the auxiliary transformer, the voltage of which is conveniently kept constant by maintaining the supply voltage constant. The non-inductive resistance R in the wattmeter shunt circuit is, however, connected to a change-over switch which puts either this resistance in series with the moving coil or replaces it by a condenser K. If a little care is taken in arranging the circuits beforehand the measurements can be made quite simple. The best way, as a rule, is first to select a suitable condenser for the moving coil circuit of, say, 1 mfd or 0.5 mfd capacity. The capacity reactance of this condenser is then $10^6/K\omega$, where K is the capacity in microfarads and $\omega = 2\pi f$. In a certain test a 0.5-mfd condenser was used with a frequency of 50 cycles, for which $\omega = 314.2$. Hence the capacity reactance = 6360 ohms. The resistance of the moving coil of the wattmeter was 620 ohms, so that the impedance of the circuit with the condenser in series was $\sqrt{6360^2 + 620^2} = 6390$ ohms, or practically the same as the capacity reactance. If the moving coil resistance (= 620 ohms) be subtracted from the above, there remain 5770 ohms, and if the non-inductive resistance R is adjusted to this value, the current in the shunt circuit will be of the same amount whether the resistance or condenser is in circuit. If use is now made of a small transformer which has a known ratio of, say, 10-to-1, and it is connected to the secondary of the auxiliary transformer, then if the potential difference of the auxiliary transformer is 100, that of the secondary of the small transformer is 10 volts and in time-phase with it. The main coils of the wattmeter, in series with its non-inductive resistance, may now be applied to the terminals of the small transformer, and the resistance may be adjusted until a convenient reading is obtained. In the experiment a torsional wattmeter with 500 divisions on the torsion head was employed, and the resistance in series with the main coils was adjusted until with 100 volts on the shunt, and consequently 10 volts on the secondary of the small transformer, there was obtained a deflection of 500 divisions, or of 50 divisions per volt. At the same time, the shunt circuit was changed over to the condenser, and a reading of 62.5 divisions was obtained. Had the change over to the condenser changed the wattmeter current into exact time-quadrature there should have been no deflection in the second case; the fraction $\frac{62.5}{500} = 0.125$ is the tangent of the angle by which the shunt current departs from time-quadrature, or $\tan\theta$ in Fig. 2, where D_1 and D_2 are the two deflections of the wattmeter with the resistance and condenser respectively in the shunt circuit. This $\tan\theta$ should



Figs 2 and 3—Vector Diagrams.

have been equal to the resistance of the moving coil divided by the capacity reactance $= \frac{620}{6360} = 0.0975$ if the condenser had no absorption, the difference $0.125 - 0.0975 = 0.0275$ being approximately the power-factor of the condenser. When

these preliminary calculations have been made and the voltage and frequency are kept approximately constant, the wattmeter becomes a direct-reading voltmeter, which, when the resistance R is in the shunt circuit, reads the component v_1 of any voltage v in time-phase with the "exciting voltage" on the shunt (in this case the voltage of the auxiliary transformer), while with the condenser in circuit it reads the component v_2 in time-phase with the condenser current. As will be seen at once from Fig. 3, however, the time-quadrature component $v_2 = v'_2 - v_1 \tan \Theta$ approximately, and, since $\tan \Theta$ is known, the two components are at once given. Details of a test made by means of this method are given.—Lond. *Electrician*, July 29.

Tests of Induction Motors.—G. H. FLETCHER.—A description of a modification of the Hopkinson test for induction motors. A test of two induction motors of large size is described. They are coupled rigidly together, one above the other, both rotors being joined by a sleeve coupling, the top machine being run as a motor and the bottom as a generator. Both stator windings are connected in parallel, and, of course, have the same direction of rotation. When the two are up to speed the rotor of the motor is short-circuited, while that of the generator is connected to the slip-rings of a rotary converter (*RC* in Fig. 4). The rotary must be supplied with energy from a low-voltage circuit—50 volts or less—a motor-generator set being used for this purpose. If, when both motors are running at full speed, current be switched on to the direct-current side of the rotary

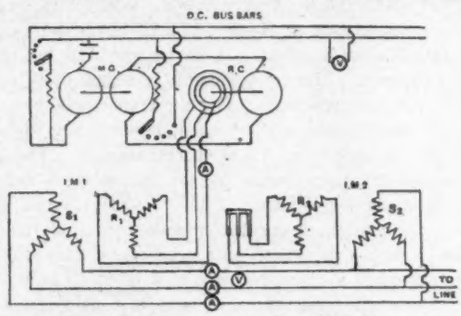


Fig. 4—Testing Induction Motors.

converter (the field of which is unexcited) the rotor R_1 will then become excited with a direct current, and an e.m.f. will be generated in stator S_1 which will be of the same frequency as that of the supply. If, now, the excitation of the rotor R_1 be increased, the e.m.f. of stator S_1 will tend to become higher than that of S_2 and accordingly a circulating current will be produced between the two machines. This will, of course, have the effect of loading up the motor, and consequently the speed will drop somewhat below the synchronous value owing to the slip. The current generated in the stator S_1 would, therefore, be of less frequency than that of the supply, and the two machines would fall out of step. If, however, the field of the rotary converter be excited, the machine will commence to revolve, and the direct-current excitation of the rotor R will be changed into an alternating current of low frequency which will have a value corresponding to that of the motor slip. No very fine adjustment of the field is necessary to obtain the right speed for the rotary, as the e.m.f. generated in the rotor of that induction machine which is run as a generator will fall into step with that of the rotary, and the two will run synchronously. One can easily find the value of field current which will give the steadiest running. The load is regulated by increasing or diminishing the voltage impressed on the commutator of the rotary; an increase in the volts will increase the stator volts generated, and, consequently, the circulating current. At the same time, it will cause the speed of the rotary to increase slightly, and will thus make up for the increased slip. The resistances of stator and rotor having been determined, and a light load reading (core loss and friction) on one machine having been obtained, the efficiency is equal to:

$$\frac{(W_1 + W_2) - (W_l + 3\,[C_s^2 R_s + C_r^2 R_r])}{W_1 + W_2}$$ where

W_1 and W_2 = wattmeter readings on underload.
W_l = light-load reading.
C_s and C_r = stator and rotor currents.
R_s and R_r = stator and rotor resistances.

Another method of determining the efficiency is as follows: Connect wattmeters in the motor and also in the generator circuits of the set. The three phases should be equally balanced, and in this case one wattmeter in each case will suffice. If there were no input from the rotary the efficiency would simply be W_o/W_1 where W_o is watts output and W_1 is watts input. However, there is also W_3 input from the rotary, where $W_3 = \eta E_r C_r$ (E_r and C_r being the direct-current voltage and current to the rotary); η is the efficiency of the machine, which, being a test machine, has been experimentally determined. The combined efficiency of the motors is now $W_o \div (W_1 + W_2)$. The power-factor and the percentage slip may also be easily determined.—Lond. *Elec. Rev.*, Aug. 5.

Compensation and Commutation.—A note on a recent British patent (15,319, 1909; July 21, 1900) of R. Pohl and the Phœnix Dynamo Manufacturing Company. In direct-current turbo-generators and alternating-current commutator machines, where the commutation conditions are difficult, the usual compensating winding is placed in the face of the main poles, but this is designed to compensate the armature reaction under the poles only. A further compensating winding is provided in the spaces between the poles, and this is designed to produce the flux for commutation also. The compensating winding is arranged close to the armature and an unwound commutating pole is fixed outside of the winding, or the winding may be in the face of the commutating pole. In order to vary the commutating field without altering the degree of compensation, reluctance is introduced into the magnetic circuit of the commutating poles in the form of a variable air-gap, or the poles themselves are moved transversely across the armature.—Lond. *Elec. Eng'ing*, July 28.

Three-Phase Commutator Motors.—F. EICHBERG.—A paper read before the Berlin Electrical Society in which the author gives, with the aid of diagrams, a simple theory of the construction and mode of operation of polyphase commutator motors. He then discusses the method of regulation, conditions of commutation and compensation. He finally gives the results of tests which show that these motors possess, within wide limits, the properties of direct-current shunt motors with field regulation.—*Elek. Zeit.*, July 28 and Aug. 4.

Leakage Reactance.—J. REZELMAN.—The conclusion of his mathematical paper on the analysis of leakage reactance. The author continues his investigations into the leakage of the windings of alternating-current machines. The expressions for the various permeance are considerably simplified and made much more general. The leakages of many machines have been carefully analyzed and the results are given. Bar windings are also dealt with.—Lond. *Electrician*, July 29.

Faults in Armatures.—W. H. F. MURDOCH.—It frequently occurs that owing to defective insulation there may be faults between the armature windings and core, or between commutator segments and shaft. The consequences of such faults are briefly discussed. Faults close together are preferable to diametrally opposite faults, and the current flowing depends on the e.m.fs. and resistances, and whether there is an odd or even number of faults.—Lond. *Elec. Rev.*, July 29.

Parallel Running.—W. WOLF.—A translation in abstract, with illustrations, of his recent German article on modern arrangements employed in Continental Europe for the synchronizing and parallel running of electrical machines.—Lond. *Electrician*, July 29.

Lamps and Lighting.

Fragility of Metallic-Filament Lamps.—A note on the deteriorating effect of vibrations on metallic-filament lamps. Attempts have been made to overcome this drawback by a spring suspension of the filament, but have not met with the anticipated measure of success. Under certain conditions the springs, which are an essential part of the appliance, are prone to vibrate

in unison with some other vibration, and thereby accentuate the trouble they were designed to overcome. The transmission of outside vibrations to the filament is prevented to a large extent, if not altogether, by a Continental method of manufacture. The foot of the lamp carries a rod arranged axially, which is surrounded concentrically by a cylindrical part, which forms the filament-holding device. The connection between the latter and the center rod is formed by springs so arranged that all vibration along the rod is taken up before the filament supports are reached. In one form the elastic connection is by means of carefully tensioned hair-springs, while in the most improved form the filament support is held concentrically with the center rod by means of one spring and is slung on two other springs arranged as part of the leading-in wires, which successfully prevent any vibration of the lamp being transmitted to the filament.—Lond. *Elec. Rev.*, Aug. 5.

Flame-Arc Lamp.—An illustrated description of a new direct-current flame-arc lamp of English make. The electrodes are inclined, but the regulation of the arc is effected entirely from the top of the lamp, the electrodes sliding axially in guides. Fig. 5 shows the arrangement of the controlling gear. It consists simply of a differential shunt and series solenoid, actuating a clutch, through the agency of a lever, against the tension of an adjustable spring. The clutch is of a very peculiar design, having three working parts enclosed in a box; one part is connected to the lever by a link, and presses a T-shaped piece against the chain, while the third part acts in the opposite sense, releasing the clutch when its toe comes in contact with the top-plate of the lamp. The flat chain is also of novel construction, presenting a perfectly smooth surface to the clutch and to the opposing wall of the box. As shown, one end of the chain is attached to a bar from which the electrodes are suspended by rollers, while the other end is attached to a balance-weight enclosed in a tube. On closing the circuit the electrodes are retracted, striking the arc to practically its normal length, after which they are gradually lowered until the toe of the clutch meets the plate; subsequently the arc is controlled by the clutch, which feeds the chain by almost imperceptible movements.—Lond. *Elec. Rev.*, July 29.

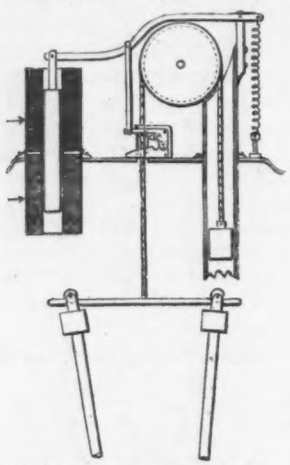


Fig. 5—Diagram of Flame-Arc Lamp.

Mercury Arc.—C. T. Knipp.—An account of an experimental investigation in which the author determined the temperature-gradients from electrode to electrode under various conditions of pressure, current, and form of tube of a mercury-vapor lamp. The average temperature of the mercury arc in a vertical tube was investigated from electrode to electrode by means of a movable thermo-junction introduced through a barometric leg of the lamp for pressures up to 3 mm mercury at a constant current of 3 amp. The temperature increased very rapidly with the pressure. The temperature-gradient along a diameter 27 mm from the anode showed a fall in temperature of 20 per cent of the whole at a distance of 12 mm from the axis in a tube 34 mm in diameter.—*Phys. Rev.*, August.

Filter for Heat Rays.—R. A. Houstoun and J. Logie.—In photometric experiments it is sometimes necessary to separate the light rays from the heat rays. This is generally done by means of glass vessels filled with water or with an alum solution. But in both cases considerable quantities of dark heat rays are permitted to pass, and, contrary to general opinion, alum solutions do not absorb the heat rays better than does water. Russler recommends solutions of ferro ammonium sulphate in water and the present authors employ such a solution containing 12.56 grams per liter. This solution is much superior to water.—*Phys. Zeit.*, Aug. 1.

Generation, Transmission and Distribution.

Electric Equipment of Steel Works.—An illustrated description of the use of electric motors in the works of the Barrow Hematite Steel Company at Barrow-in-Furness. The various shops, the machinery in the iron works and in the rolling mill, the blast-furnace hoists, pumping and other plant are electrically driven, and in all some 120 motors are installed, aggregating about 2500 hp. Energy is generated by three large gas-engine sets operated with blast-furnace gas, and is distributed at 220 volts direct current on the two-wire system by means of bare overhead cables.—Lond. *Elec. Eng'ing*, July 28.

Condensers.—M. Leblanc.—The conclusion of his illustrated article on his condenser, with special reference to the construction and arrangement of the rotary pumps.—*La Lumière Elec.*, July 23.

Traction.

Prussian-Hessian State Railways.—K. Wiesinger.—An article on the development of electric operation on the Prussian-Hessian State Railways which are to be operated by 15-cycle, single-phase current. The trolley e.m.f. is 10,000 volts, and the transmission e.m.f. 50,000 volts. For the trial roads, two different kinds of locomotives will be used, serving for high-speed passenger service and freight service respectively. The author gives some constructive details of the locomotives according to proposals made by Wittfeld. They contain large driving wheels near the center of the locomotive and small trucks or running axles with a moderate axle pressure at the ends. The motors are placed at a comparatively high level. The reduction of the axle pressure from 16 to 14 tons is considered a great advantage of electric traction, which, in connection with the quiet running of the electric locomotive, will reduce considerably the cost of maintenance of the roadbed.—*Elek. Zeit.*, Aug. 4.

Surface-Contact System.—Some notes on the troubles experienced at Torquay with the Dolter surface-contact system, due to a large number of defective studs and an alleged excessive cost of maintenance. It is claimed that the number of stud failures has been unduly increased by the fact that so many have been allowed to remain in a defective condition. On the other hand the working cost is thought not to be higher than in other hilly towns where the trolley system is used. Figures are given showing that at Bradford, Halifax and Huddersfield, all working on the trolley system, the energy per car-mile is 1.88, 1.97 and 2.25 kw-hours respectively; the revenue per car-mile is 20.66, 22.16 and 19.46 cents respectively; and the costs per car-mile are 14.44, 21.0 and 18 cents respectively. These figures are then compared with those of Wolverhampton, Lincoln and Torquay, all surface-contact systems, and, of course, running a less number of car-miles per year. In these cases the kw-hours per car-mile are 1.56, 1.11 and 2.24 respectively, while the revenue per car-mile is 20.94, 18.40 and 20.1 cents. The cost per car-mile in the case of Wolverhampton is 13.2 cents and in the case of Torquay 20 cents, while the figures for Lincoln are not given. At Torquay the management and general expenses are high. The cost of repairs and maintenance is not considered excessive, but the cost of energy is high. The high energy consumption is due chiefly to the hilly nature of the town. The price charged to the company for electrical energy is 3.14 cents per kw-hour.—Lond. *Elec. Eng'ing*, July 28.

Trackless Trolley Systems.—An account of the report of the committee sent by a British central station to Continental Europe to investigate the different trackless trolley systems in

practical use. The conclusion is that the railless trolley systems as used in Vienna and in Italy are such that either system could be adapted to English conditions and prove of great value to tramway authorities and to the public in providing a means of transit to districts where the heavy capital cost would prohibit the construction of an ordinary tramway.—Lond. *Electrician*, July 29.

Liverpool.—An abstract of last year's financial account of the Liverpool tramway system. While the number of passengers and total receipts have decreased by 0.3 per cent against 1909, the net profit has increased due to economies in the management. The total expenses, including capital charges per car-mile for 1909, were 20.30 cents and the total revenue 23.78 cents.—Lond. *Electrician*, July 29.

Installations, Systems and Appliances.

Central-Station Statistics for Germany.—G. DETTMAR.—The author first gives some statistical data supplementary to last year's statistics of the central stations of Germany and then sums up the situation as existing on April 1, 1910. The total number of central stations on that date is estimated as 2358, supplying electrical energy to 6470 cities and towns. The total rating is 1,373,000 kw. With respect to the kind of prime movers employed, it is stated that 767 stations employ steam, 214 water, 350 internal-combustion engines, while 51 are transformer or converter substations. Both water and steam are used in 390 stations, while the nature of the prime movers is not known for the balance of the stations. Fifty-two stations employ single-phase current, 241 three-phase currents, 1736 direct current, while the balance employ either a mixed system or did not give any information on this subject.—*Elek. Zeit.*, Aug. 4.

Statistics of Austrian Electricity Stations.—On July 1, 1910, there were 675 central stations in Austria (against 571 last year), supplying energy to 1500 towns. There were 241 municipal stations and 434 were owned by corporations or private parties. The data relate to 19 stations which supply, besides energy for lamps and stationary motors, also energy for traction, but all pure traction stations are excluded. The number of stations transmitting energy over an extended district is 139, that of high-tension plants is 225. The total rating of all works is 318,614 kw, against 285,353 kw last year; the greatest increase was in the three-phase stations, the smallest in the direct-current stations with storage batteries. There are 238 direct-current stations with storage batteries (57,342 kw), 165 direct-current stations without storage batteries (8689 kw), 15 single-phase stations and 5 two-phase stations (total rating, 41,525 kw), 192 three-phase stations (94,156 kw), 37 combined three-phase and direct-current stations (116,902 kw). For the balance of the stations the system was not reported. Of the stations, 145 have a rating up to 25 kw, 105 stations to 50 kw, 129 to 100 kw, 114 to 250 kw, 58 to 500 kw, 48 to 1000 kw, 23 to 2000 kw, 18 to 5000 kw and 10 have a rating above 5000 kw. Of the stations 127 are operated by steam, 308 by water, 87 by steam and water, 52 by internal combustion motors, 15 by steam and internal combustion motors, 42 by water and internal combustion motors, and 11 by water, steam and internal-combustion engines. The total rating of all the prime movers is 475,954 hp, against 410,459 hp last year. Overhead wires are used in 326 stations, cables in 17 and both overhead wires and cables in 186. As to the methods of charging for energy the following figures are given:

TARIFF SYSTEM	NUMBER OF STATIONS	
	For Lighting Lamps	For Motors
Meters without discount	136	126
Meters with discount	120	106
Flat-rate	181	107
Mixed tariff (meters and flat-rate)	108	78
No information available	130	258

As to the age of the different stations there were four in existence at the end of 1888. The number of new stations erected reached a maximum in 1905, when 62 stations were opened, while the numbers of stations opened in 1909 and 1910 were 36 and 33 respectively.—*Elek. und Masch.* (Vienna), July 31.

Electricity in Agricultural Districts.—H. WALLEM.—The conclusion of his paper read before the German Association of Electrical Engineers on the use of electric energy on farms. In the present installment the author discusses the chief conditions to be fulfilled in order to make an electric distribution system in agricultural districts profitable. By means of equations and curves he discusses the relation between capital invested, cost of operation, selling price of electric energy, and the number of kw-hours which must be sold per year to make the system profitable. In discussing how the energy required for agricultural purposes may best be generated, he points out that it is used chiefly during the day and at hours while the load on central stations in cities is low. For this reason he thinks that central stations in cities surrounded by agricultural districts would do well to consider the supply of energy to farmers, or to a substation for farmers. This energy could be supplied cheaply, since the demand of the farmers would not increase the maximum demand of the station, but would tend to equalize the load. The author finally estimates the possibilities of electric energy distribution over the agricultural districts in Germany for the next 25 years and thinks that there is a promising field here for electrical developments.—*Elek. Zeit.*, July 28.—A long discussion on the subject of transmission and distribution systems for agricultural districts following the above and several other papers presented at the recent meeting of the German Association of Electrical Engineers was opened by the Secretary of Commerce, Von Podbielsky, and participated in by various speakers. The report of the meeting is given in full in *Elek. Zeit.*, July 28, page 765, and Aug. 4, page 791.

Wires, Wiring and Conduits.

Fuses.—R. EDLER AND R. SCHUSTER.—An account of experiments with fuses of silver wire, copper wire and lead wire in porcelain tubes. The length of the fuse wire depends only on the voltage, while the diameter depends on the current. As to the relation between the diameter d of the fuse wire and the maximum current i_m which it can carry continually without melting, the equation $i_m = cd^x$ holds good. If i_m is given in amperes and d in millimeters the values of the constants c and x are as follows: Silver, $c = 44.5$, $x = 1.558$; copper, $c = 62.5$, $x = 1.48$; lead, $c = 6.5$, $x = 1.575$. With respect to the relation between this maximum current i_m and the normal current i of operation reference is made to the regulations of the Vienna Electrical Society, according to which a fuse for a normal current of i amperes must be able to carry continually 33 per cent overload, but must melt certainly within two minutes if the current becomes twice the normal. As first approximation one may therefore select the dimensions of the fuse wire so that the normal current i is 75 per cent of the maximum current i_m. The relation between i and d is then of the same form as above, the values of x remain the same, but the values of c are three-fourths those given above. The authors then discuss on the basis of experiments the following two problems. First, after what time does a fuse melt with double the normal current $2i$ as defined above? and secondly, what is the temperature of the fuse wire at the normal current i? The results are given in form of tables and diagrams. In the second part of the paper is given the theory of the problem which is shown to agree with the experiments.—*Elek. und Masch.* (Vienna), July 24 and 31.

Earthed Concentric Cables in Collieries.—W. B. SHAW.—For direct-current colliery work the author favors a system in which the outside earthed metallic layer or armoring is used as one of the current-carrying conductors, the cable being made as a single-core armored cable. A substantial earth connection should be made to the negative busbar on the main switchboard, and taken to two independent grounds. In the discussion which

followed, some speakers thought the concentric system to be a thing of the past, owing to difficulties in its installation.—Lond. *Elec. Eng'ing*, Aug. 4.

Electrophysics and Magnetism.

Photo-Electricity.—O. Stuhlmann.—An account of experiments in which the author established a difference in the photo-electric effect caused by incident and emergent light. The author's experiments show that when beams of ultraviolet light of equal intensity are compared, the ionization they produce is greater on the emergent than on the incident side of a thin platinum film. For a film so thin that the absorption of the light in it is negligible, the ratio of the ionization on the emergent to that on the incident side is as 1.17 is to unity. There is thus an increase of 17 per cent in favor of the emergent side of the film. An effect of this kind would obviously be expected on any corpuscular theory of light. It can also be explained on an undulatory theory by a process of the nature of light-pressure, which tends to push the electrons forward in the direction in which the light is propagated. In its ordinary electromagnetic form, however, the undulatory theory does not appear to give rise to effects large enough to explain the phenomena observed. The difficulty appears to be similar to that which arises when the ordinary theory attempts to explain why the ultraviolet light is capable of causing the expulsion of the electrons, with their observed properties, under any circumstances.—*Phil. Mag.*, August.

Constant Current from Constant Potential.—J. Bethenod.—An article on an arrangement suitable for obtaining constant current from constant-voltage supply, and the reverse. When upon a circuit containing a condenser and a transformer there is impressed a constant voltage and the primary self-induction and the capacity fulfill the condition of resonance, a constant current is obtained in the secondary. A special case of this is the method of Boucherot in which the transformer is replaced by a simple inductance coil. The method is generalized by the author for a number of transformers connected in cascade.—*La Lumière Elec.*, July 30.

Demagnetizing Factors.—C. L. B. Shuddemagen.—A brief paper giving tables of demagnetizing factors for iron rods.—*Phys. Rev.*, August.

Absorption Lines.—P. Zeeman and B. Winawar.—A second paper on the magnetic splitting of absorption lines and its connection with the spectrum of sun spots.—*Phys. Zeit.*, Aug. 1.

Electrochemistry and Batteries.

Ozone.—D. H. Kabakjian.—An account of an experimental investigation of the formation of ozone by the silent electric discharge. In all cases studied by the author the quantity of ozone produced in a given ozonizer was found to be, over quite a large range, almost directly proportional to the current, after a full steady discharge is established and practically independent of the voltage. The phenomenon cannot be explained by the increased ozone density or by the deozonizing effect of the current, as these were varied in many different ways and yet the above relation seems to hold good in general. A given current passing through a given volume of air does not produce the same amount of ozone in different ozonizers. Other things remaining the same the yield in grams per coulomb increases with decrease of capacity. The output of the ozonizers, such as described in this paper, in grams per kw-hour, was found to increase with increase in capacity.—*Phys. Rev.*, August.

Units, Measurements and Instruments.

Thermo-Elements.—W. P. White.—An account of an investigation of the thermo-element as a precision thermometer. The e.m.f. of a thermo-element, whether homogeneous or not, can be expressed as equal to $\int H dT$ (H thermo-electric power, T temperature). It follows that the effect of each portion of a thermo-element is proportional to the magnitude of the temperature gradient in which it lies; hence the vital parts of a thermo-element are the parts along which the temperature varies; they mainly determine the calibration and the constancy; with them alone need the maker or user of the thermo-element be much concerned. In changing them (as by varying the depth of immersion in a furnace) the thermo-element itself is changed, if not homogeneous, while alterations in regions of uniform temperature distribution, as at the junction, have little effect on the temperature measurement. Commercial constantan wire good enough to make thermo-elements accurate to about 0.05 per cent is easily obtained and causes but little trouble in the selection, but cannot be relied upon without any test for possible non-homogeneity. A compensated thermo-element of higher accuracy, reading consistently to 0.0001 deg. for use at ordinary and low temperatures, can be made in a day or two. Improvement in the accessory apparatus has shown that their constancy is about 10 times that shown three years ago. The accuracy of 0.0001 deg. reached by the thermo-element can also be attained in its auxiliary apparatus (potentiometer, etc.). The resulting accuracy, both absolute and relative, and the sensitiveness are quite comparable with those of the best resistance thermometers yet used. For the measurement of single temperatures, the resistance thermometer is often more convenient. On account principally of the comprehensiveness of the potentiometer and its indifference to external contact resistances the thermo-element is usually preferable where several different measurements are to be made at one time. The thermo-element is also usually superior for differential measurements, and its advantages in this respect can be made available for calorimetric work by the substitution of a suitable comparison body for the usual ice bath. A very convenient wire-tester, a simple bath for testing and comparing thermo-elements, and a convenient form of tabulation for calibration, are also described.—*Phys. Rev.*, August.

Calibration of Thermo-Elements.—W. P. White, H. C. Dickinson and E. F. Mueller.—A pair of copper-constantan thermo-elements for use in calorimetric work was calibrated by comparison with resistance thermometers to an accuracy of 0.004 deg. It seems probable that the accuracy of the calibration could be considerably exceeded. A cubic equation probably represents the relation between temperature and electromotive force in the interval 0 deg. to 100 deg.; with an accuracy of 0.005 deg. or better. New thermo-elements may be very conveniently calibrated by direct differential comparison with those whose calibration is already known.—*Phys. Rev.*, August.

Instrument Transformers.—K. Edgcumbe.—The author discusses the errors which can be introduced by instrument transformers and which are due to an error in the ratio of transformation or to a time-phase displacement between the primary and secondary currents or pressures. He shows, however, that, given satisfactory design and rational precautions as regards range and secondary load, the errors introduced by the use of series and shunt transformers with measuring instruments are so small as to be negligible in practice.—Lond. *Elec. Rev.*, July 29.

Telegraphy, Telephony and Signals.

Telephone Exchange.—Janzen.—A continuation of his long illustrated description of the new long-distance telephone exchange in Hamburg, Germany. In the present installment he gives details of the switchboard construction.—*Elek. Zeit.*, July 28.

Wireless Telegraphy.—P. Brenot.—An illustrated review of the present situation of wireless telegraphy and telephony.—*La Lumière Elec.*, Aug. 6.—An article by Henry gives brief sketches of the methods used in wireless telegraphy and telephony due to Fessenden, Balsillie, Collins, Jeance and Colin, von Lepel, and the Telefunken Company.—*L'Industrie Elec.*, July 25.

Miscellaneous.

Tests of Feed Water.—W. P. Digby.—The author first describes a form of conductivity tube which he has devised for use, not only in the physical laboratory, but in every-day engineering work. It furnishes information as to whether condensers are leaking, the amount of the leakage, the amount of priming arising in boilers, and the control of oil-eliminating and water-softening plants. Details of tests carried out at various power stations are given.—Lond. *Electrician*, July 29.

BOOK REVIEWS

MAKERS OF ELECTRICITY. By Brother Potamian, F.Sc., D.Sc., and James J. Walsh, M.D., Ph.D., LL.D. New York: Fordham University Press. 404 pages, illus. Price, $2.

This handsome book contains biographical notices, and résumés and appreciations of the work of twelve of the great pioneers and masters of electrical science, namely: Peregrinus, Norman, Gilbert, Franklin, Galvani, Volta, Coulomb, Oersted, Ohm, Faraday, Maxwell and Kelvin. Of the joint authors, Brother Potamian needs no introduction to electrical readers, and Dr. Walsh is doubtless known to many in this circle through his writings on the historical side of science. One of the objects of the work is to bring out that there is no incompatibility between religious belief and profound knowledge of science; and in the preface it is noted that all of the great men whose lives and work are sketched were "firm believers in the existence of Providence, of a Creator, of man's responsibility for his acts to that Creator, and of a hereafter of reward and punishment where the sanction of responsibility shall be fulfilled." This object, however, is not made obtrusive, the references to the religious belief of the several subjects differing little from what would be considered appropriate in an account of their lives emanating from a strictly secular source.

The book is, however, more than a record of the work of the men who are the titular subjects of the various sections. The chapters covering the period down to Volta give a connected history of the evolution of electrical science from the earliest days to that date, and in the following sections the work of the men who are the subjects of chapters is related with that of predecessors and of contemporaries. A goodly part of the contribution of Brother Potamian (which covers the period to Galvani and includes also the chapters on Oersted and Kelvin) originally appeared in these columns, but this matter is here related with the work of other men and placed in proper perspective with the general plan of the book, which is that of a biographical history of electricity. Of particular interest and of much value for reference are the results of his researches in the early history of magnetism, given in the chapters on Peregrinus, Gilbert and Norman, and on the discovery and first experiments with the lightning rod, given in the chapter on "Franklin and Some of His Contemporaries." Other notable features are his accounts of investigations that barely missed anticipating the discoveries of Galvani, Volta and Oersted, and the several notices of early forms of electrical telegraphs.

Among the omissions we note that in the chapter on Volta reference is not made to the curious form of electrostatic telegraph he suggested in 1777; and in the chapter on Faraday there is no mention of the experiment of Colladon of Geneva in 1825, which only missed the discovery of electromagnetic induction on account of the employment of a galvanometer which could not respond to instantaneous currents. In reference to the electrical telegraph, the two most important steps in its invention are passed over—those made by Schilling and Henry. The principles of the modern telegraph are almost entirely contained in the Henry bell telegraph of 1830 and the Schilling needle telegraph of 1832. While Morse will always occupy a high place in the history of the telegraph, he, like Fulton, was rather the promoter to a commercial stage of the ideas of others than a creative factor in his field in other than an industrial or commercial sense. While considerable space is given to the Ronalds telegraph of 1816, no mention is made of its Sommering prototype of 1809. We note that the portrait of Ampere is a reproduction of the counterfeit presentment occasionally seen in print, which bears no resemblance to the homely but strong face of the great savant.

Aside from the intrinsic interest of its matter the book is delightful to read owing to the graceful literary style common to both authors. One not having the slightest acquaintance with electrical science will find the book of absorbing interest as treating in a human way and with literary art the life-work of some of the greatest men of modern times; and, moreover, in the course of his reading he will incidentally obtain a sound knowledge of the main principles upon which almost all present-day electrical development is based. It is a shining example of how science can be popularized without the slightest twisting of facts or distortion of perspective. Electrical readers will find the book also a scholarly treatise on the evolution of electrical science, and in reading a most refreshing change from the "engineering English" of the typical technical writer.

THE CORROSION AND PRESERVATION OF IRON AND STEEL. By Allerton S. Cushman and Henry A. Gardner. New York: McGraw-Hill Book Company. 373 pages, 68 ills. Price, $4.

Corrosion of metals is beginning to attract attention in a measure more in proportion to its importance than formerly. Steel now enters into all classes of construction, and upon the permanence of structural material depends the safety of thousands of lives and the saving of millions of dollars. The subject of corrosion is so important that everyone owning, designing or building metallic structures should be fully informed on the subject and understand as thoroughly as may be possible just how much can be done to prevent destruction of property by corrosion. Much experimental work has been done and many papers have been written, but the book of Cushman and Gardner appears to be the first to gather and digest the present knowledge on the subject of corrosion of iron and steel and the properties and virtues of protective coatings. The first part of the book is given over to theoretical discussion of corrosion, and after presenting the various theories, the authors declare themselves in favor of the electrolytic theory and proceed with the subject on that basis. The iron and steel manufacturers' side of the subject is treated by pointing out the effects of chemical composition, heat treatment and mechanical working on the inhibition and stimulation of corrosion, thus indicating the proper methods of manufacture to secure a non-corrosive metal. The consumers are more concerned with the latter half of the book, which tells of methods of protecting from corrosion the metals now on the market. This part of the book is undoubtedly the most valuable and at the same time of interest to the most people. That part of the book which takes up the protection of metallic surfaces by the use of coatings and special treatments is given up largely to the study of paints, and this branch constitutes in itself a most valuable contribution to the literature of paint manufacture, testing and the properties of pigments and paint vehicles.

At the end of the volume is given a bibliography compiled from lists of the Carnegie Library of Pittsburgh and various other sources. This list is brought right up to date, with remarks accompanying each reference.

ILLUMINATION AND PHOTOMETRY. By William Elgin Wickenden. New York: McGraw-Hill Book Company. 203 pages, 116 ills. Price, $2.

The subject of illumination, or illuminating engineering, as some prefer to call it, is coming rapidly into prominence and a number of colleges now offer courses in the subject. The lack of a suitable text-book has hampered the study of illumination and made it necessary for each teacher practically to write a book of his own.

Professor Wickenden has collected and presented in a clear and interesting manner such information as should form the basis of an illuminating engineer's education. The subject is introduced by a discussion of radiation and light, followed by photometers and methods of measuring light. The latter half of the book is given up to a description of the various illuminants, including gas and electric lamps, with rules and directions for their use in illumination. At the end of the book various tables useful in the calculation and design of illumination are given.

The calculation of illumination involves no new principles, but when a subject is lifted out of the realm of physics into that of practice, it must necessarily undergo a great change in

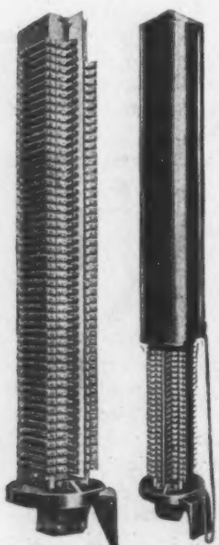
many details. All terms of negligible magnitude are ignored and approximate methods are introduced which enable the engineer to get quickly results which are sufficiently accurate for practical work. Development in this direction is very active just at present and, therefore, this book can scarcely be expected to include what appear now to be the most practical methods of calculating illumination. The calculations are here based on the point-by-point and flux-of-light methods, and attention is called to the effect of reflection, and the effect explained with the aid of a series of infinite reflections, a method which is common and which is also responsible for the tendency to neglect reflection in calculations. The absorption-of-light method now becoming recognized offers an extremely simple means of including reflection, which, contrary to common belief, plays an extremely important part in illumination. The absorption-of-light method enables the designer to ascertain in a few minutes the amount of power and light flux required to give a certain illumination in a given space without regard to location of the lamps. When the lamps are located the efficiency of the location can be checked by comparison of the total flux of the lamps with that obtained by the absorption method. Attention is called to this method with the hope that it may be included in the future editions of this most excellent book. It is the best text-book that has come to our attention and should have little difficulty in holding its place by suitable revision for many years to come.

New Apparatus and Appliances

PROTECTED CABLE TERMINAL.

A new cable terminal recently placed on the market by the Western Electric Company is designed to replace the compact, hooded, but unprotected type, and the cumbersome wooden-box protected terminal, although combining all of the advantageous features of those two older types. The terminal is a compact, weatherproof device which affords protection to the central office equipment against lightning discharges and accidental contact with electric light wires. The "No. 18" protected cable terminal, which is illustrated in Figs. 1 and 2, consists essentially of a rectangular oiled and shellaced wooden box into which the cable is led. Two sides of this box serve as mountings for the fuse clips and as fanning strips for the bridle wires. The third side of the box acts as a support for cut-outs.

During manufacture the interior of the box is filled with waterproof pot-head compound, which fills the space between the fanned-out wires and seals the end of the cable against moisture. The box is mounted on a cast-iron base, or bracket, in the center of which is fitted a wooden bushing for clamping the cable in place and relieving the wires of all strain. The cable chamber, binding posts and connections are protected against weather by a heavy reinforced, galvanized sheet-iron hood which may be lifted to any height necessary to examine the fuses, etc. The hood is held at the desired height by a spring latch mounted on top of the fanning strips. However, should the hood be removed completely it will be prevented from falling to the ground by a non-corrosive sash-chain which attaches it to the bracket. The protective devices supplied consist of fuses and open-space, carbon-block cut-outs, two of each wired into each pair of wires; the cut-outs are arranged to be connected between the fuses and the cable. The Western Electric Company manufactures this type of protected terminal for use with No. 22 gage wire, paper insulated, lead-covered cable in sizes of from 10 to 60 pairs of wires.



Figs. 1 and 2—Cable Terminal without and with Cover.

Ordinarily the terminal is supplied with a 6-ft. cable stub which is spliced to a cable of sufficient length to make the connection desired. However, where possible the terminal should be ordered with a cable of the required length, thereby eliminating one splice.

BATTERY CHARGING RHEOSTAT.

The rheostat shown in the accompanying illustrations is based on the "compressible resistor" method of regulating current for starting and controlling electrically operated machines, which consists in causing the current to flow through a column of disks loosely piled one upon the other within an insulated metal tube. These disks are constantly in more or less intimate contact, and the resistance of the loosely piled column may be decreased at will by compressing the disks, thus perfecting the contacts and increasing the conductivity of the column.

This principle has recently been applied to the regulation of current for charging storage batteries, for which service it possesses a number of advantages. The rheostat shown, known as the Allen-Bradley charging rheostat, and made by the American Electric Fuse Company, Muskegon, Mich., consists of one, two or four resistor tubes with suitable compressing mechanism

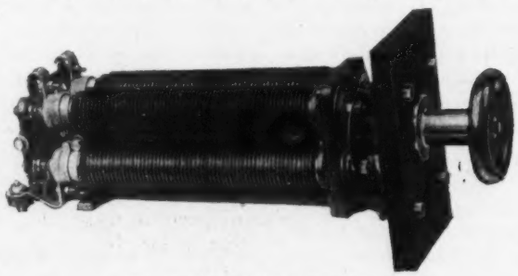


Fig. 1—Four-Unit Rheostat.

and an operating hand wheel. There are thus no segments or contact plates, no sections of coils or cast grids with their accompanying heavy copper leads, no step-by-step variation and no interruption of the circuit during charging. The resistance units are well ventilated and the tubes are provided with radiating fins to facilitate the dissipation of heat. Due to its simple construction, the rheostat can be installed in very much less space than is required by apparatus which secures resistance through banks of coils or grids.

The compressible resistor varies the resistance by infinitesimal gradations, thus insuring a delicacy of control and close regulation which enables the desired charging rate to be maintained to a fraction of an ampere throughout the entire charging period. Moreover, the principle of regulation of current through imperfect electrical contact enables the rheostat to cover a very wide range. A single rheostat can be used in charging any number of cells from 6 to 48 and at almost any desired rate, the maximum rate rising with number of resistors employed.

Freedom of this type from arcing or burning is apparent, as there are no contact plates or segments and no wide differences in potential due to step-by-step variations, hence no opportunity is offered at any point for arcing or burning. The makers state

that the resistance disks are subjected during the manufacturing process to a temperature of 7000 deg. Fahr. and also undergo severe tests for mechanical strength; the resistance will therefore withstand extraordinary heat and abnormal mechanical strains and for all practical purposes is indestructible. The

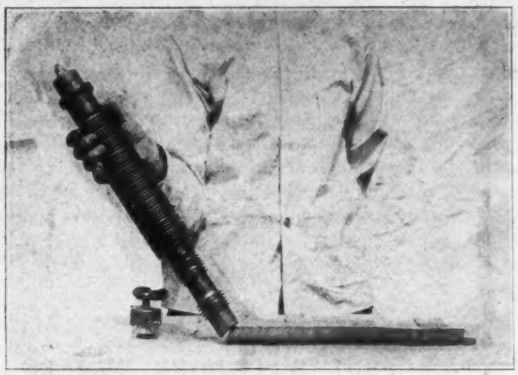


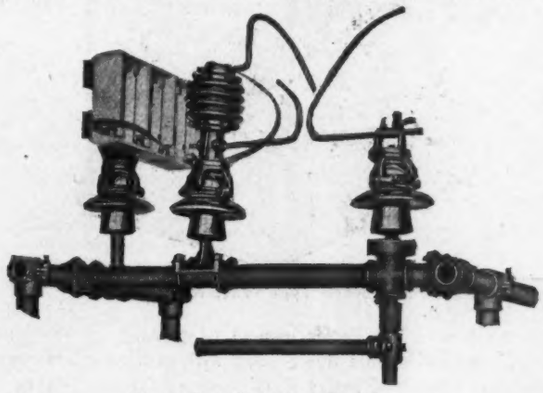
Fig. 2—Details of Resistor Switch.

charging rheostats are especially adapted for large installations and for use where the work to be performed is subject to constant and wide fluctuation, such as train lighting, laboratory and electric-vehicle service. In this latter service their wide range of operation gives them a special advantage. They are, however, also adapted for charging storage batteries for any service whatever and of any size.

ALUMINUM-CELL LIGHTNING ARRESTERS FOR UNDERGROUND CABLES.

One of the most serious problems with which operators of underground cable systems have to contend is the protection of the cables against internal surges and against lightning in cases where the underground circuits are connected to overhead lines. During the past two years the aluminum-cell arrester has been given a very wide application in the protection of cable and mixed overhead and cable circuits; in fact, it is said to have practically superseded all other forms and with its recent improvements is still better adapted for this class of service.

One characteristic of the aluminum-cell arrester which has an important bearing on this application is the daily charging of the cells—a process which consists simply of subjecting the stacks



Horn-Gap Charging Resistor.

of aluminum cones to the line voltage and short-circuiting the series horn-gaps for a brief period. This charging process, as well as normal discharges resulting from high-voltage disturbances, is accompanied by a slight arcing at the horn-gaps. On cable systems where the electrostatic capacity is large compared with the inductance of the circuit, it is advisable to take every possible precaution to limit the charging current to a minimum value.

In the General Electric aluminum-cell arrester this result is accomplished by means of a special horn-gap used in connection with a charging resistor. The resistance limits the charging current and even if the cells are in poor condition smooths out the wave-shape of the current and damps out any tendencies to oscillate. At the same time it does not prevent the cells from taking their full charge. These auxiliaries are so arranged as to give selective paths to the cells; one is through a horn-gap without resistance, which is the same as in the arresters for overhead circuits, and the other through a resistor and a horn-gap, the setting of which is slightly less than that of the gap without resistance. With this arrangement the daily charging current and the average surge discharge take the path through the resistor. The resistance of the resistor is adjusted so that it will modify the nature of the charging arcs until there is no liability of resonance occurring. It also makes the charging more uniform and reliable.

Heavy discharges which will be impeded somewhat by the resistor will be shunted through the principal horn-gap and have a free path without resistance. The arc from this discharge, rising on the horns, will be intercepted by the horn blade, which is connected to the resistor, and hence the current is limited at the end of the discharge and as the arc breaks. Thus surging which would be produced by the breaking of a large current arc in air is entirely eliminated by having the arc and current suppressed. Thus the safety horn-gap with the charging resistor combines a number of valuable features in safety of operation without in any way decreasing the efficacy of the arrester as a protector of cable systems.

MOTOR-DRIVEN ERASER.

It is a fact well known to draftsmen that mistakes in inking tracings are not infrequent and that changes in design are frequently necessary so that alterations must be made in the tracings. With a light, fast motion the ink may be removed without injury to the tracing cloth; but there are very few draftsmen who have the patience to do the work without putting too much pressure on the rubber, and thereby producing a scar on the cloth.

A rapidly revolving circular eraser, electrically driven through a flexible shaft by a small motor, places at the disposal of every drafting room a perfectly satisfactory means of removing ink from tracings. The motor-driven eraser shown herewith is equipped with a 0.05-hp motor, running at 1700 r.p.m.,

Motor-Driven Eraser.

and taking energy from any convenient lighting socket. The circular eraser is securely fastened in place by a wing to allow for renewals. A cleaning rubber is arranged to touch the rotating circular eraser very gently and remove the ink which would otherwise collect; adjustment is made by the movement of a sleeve on the handle of the erasing head. The flexible shaft is about 3 ft. long, and permits a large tracing to be covered, because the shaft can be bent in a curve of short radius.

A single erasing outfit is sufficient for any ordinary drafting room, as it is customary to locate the eraser permanently on one table and bring all the work there. This equipment is manufactured by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

THE "ROTARY CLUB" MOVEMENT.

The formation of the National Association of Rotary Clubs of America at a convention of representatives of 17 Rotary clubs, held in Chicago, on Aug. 15-17, directs attention to the growth and extent of the Rotary Club movement. It is not strange that the first convention of the National association was held in Chicago, for the parent Rotary Club was formed in that city six years ago by Mr. Paul P. Harris, a Chicago lawyer. Inasmuch as a cardinal principle of the Rotary Club is that members shall help one another in business, and as a number of electrical men are members, some account of the movement may be of interest to our readers.

The distinctive principle of the Rotary Club idea is reciprocity in business among members. The Rotary Club says frankly to its members: "Cultivate your fellow-members and use them to get business from; they in turn will do the same by you." Not only are members expected to buy goods from one another, but they direct their friends and customers to fellow-members of the club. A member is not obliged to favor his fellow-members in this manner, but he is expected to do so whenever possible in pursuance of fair and reasonable business methods. To carry out this plan, the membership of each club is limited to one representative of each line of business, and he must be either a proprietor, partner or corporate officer in a legitimate business or professional undertaking. Clergymen, physicians and lawyers are members. Members are elected only by unanimous vote, and all applications for membership are scrutinized carefully, the idea being that once a member, the other members may have no hesitation in recommending the applicant as to character and responsibility.

Rotary clubs are now established in about 20 cities of the United States, and it is said that the total membership is about 3000. This means that practically 3000 different business houses are represented, and it is asserted that the amount of capital represented is about $300,000,000. Thus the organization is already a powerful one, and it is said to be growing steadily, as all its members are loud in its praise, being benefited automatically by membership in it. It may be mentioned also that considerable attention is paid to social relations among members, thereby promoting good-fellowship.

The National Association of Rotary Clubs has a membership composed of clubs and not of individuals. The initiatory fee is $50 for each club, and the dues are $1 a year for each member of the club. In the case of the Chicago club, with its 350 members, this will amount to $350 a year. As set forth in the constitution adopted at the recent Chicago convention, the National Association has five objects: (1) To extend and develop "Rotary" principles; (2) to unify the work and principles of affiliating clubs; (3) to arouse and encourage civic pride and loyalty; (4) to promote progress and honorable business methods; (5) to advance the business interests of the individual members of the affiliated Rotary clubs.

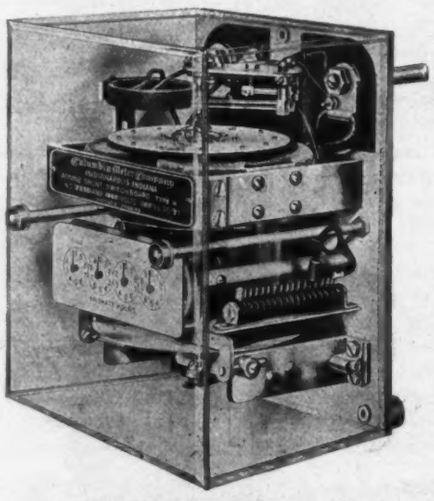
The officers of the National Association are: President, Mr. Paul P. Harris, Chicago; first vice-president, Mr. R. R. Denny, Seattle; second vice-president, Mr. Bradford A. Bullock, New York; treasurer, Mr. Elmer A. Rich, Chicago; sergeant-at-arms, Mr. Werner Hencke, St. Louis. There is also a board of nine directors, and this body will appoint a secretary and select the next place of meeting, for which Portland, Ore.; Kansas City and St. Louis are applicants.

Rotary clubs are in existence in Boston, Brooklyn, Chicago, Cincinnati, Detroit, Indianapolis, Kansas City, Lincoln (Neb.), Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Oakland (Cal.), Portland (Ore.), St. Louis, St. Paul, San Francisco, Seattle and Tacoma.

The president of the Chicago club is Mr. A. M. Ramsay, contract agent of the Chicago Telephone Company, and among others Chicago electrical men who are members are: Messrs. Charles E. Browne, American Electrical Supply Company; I. B. Eberhardt, George P. Benton Company; Carl J. Metzger, Woods Electric Vehicle Company; Henry Newgard, Henry Newgard Company; G. M. Proudfoot, Chicago Engineering & Inspection Company; G. A. Roth, Roth Brothers Company, and Thomas H. Sidley, Robinson-Sidley Company. Mr. Bion J. Arnold is an honorary member. Electrical men in St. Louis who are members of the Rotary Club in that city are: Fred B. Adam, Frank Adam Electric Company; Charles W. Brainerd, Franklin Electric Manufacturing Company; Fred E. Briner, C. J. & F. E. Briner; Edwin F. Carter, Bell Telephone Company; John A. Laird, consulting engineer; W. N. Matthews and Claude N. Matthews, W. N. Matthews & Brother; T. O. Moloney, Moloney Electric Company, and Charles Scudder, Jr., Wesco Supply Company.

DIRECT-CURRENT WATT-HOUR METERS FOR SWITCHBOARD.

In perfecting, after several years of experimentation, the astatic, shunted-motor type of direct-current watt-hour meter shown herewith, the Columbia Meter Company, of Indianapolis, Ind., strove for at least three qualities: accuracy, sensitiveness on light loads and adaptability of design for switchboard work. Many meters in counteracting the effects of stray fields have two armatures on the same revolving element, or two ammeters wound as one. The armature of the Columbia meter, by which the effects of induction and stray fields are nullified, consists of six small coils placed parallel and equidistantly around the shaft, with a separate magnetic core for each coil, each core extending radially outward from both ends of the coil with the ends of the cores divided into a plurality of paths. A six-part silver commutator is used in connection with these coils and the armature being somewhat heavier than that of house-type meters revolves on diamond jewels. Shunts may be used in



Switchboard Type Watt-Hour Meter.

connection with the meter instead of passing all the current through the series coils, doing away with expensive and cumbersome connections of heavy terminals direct to the meter. All of the company's astatic meters are of 10-amp capacity and are connected to shunts of suitable size, which may be placed behind the switchboards or in any other convenient place and connected in series with the main lines. The shunts have a drop of about 100 millivolts and are well ventilated. When it is desired to check the meter, it is disconnected from the shunt and tested as an ordinary 10-amp meter. The company manufactures another meter which differs only from the one shown in that it has a round glass case.

Industrial and Commercial News

THE WEEK IN TRADE.

THE condition of trade during the past week shows considerable improvement over previous reports. This is especially noticeable among the wholesalers and jobbers, who declare that fall orders are now coming in in better quantities than at any time during the season. The most marked improvement is in the West, where general rains have improved the crop condition, and where house trade has expanded as the result of the arrival of country buyers. Southern trade has been slower to expand. There is still a disposition to go slowly in that section, pending a clearer view of the cotton crop, which has, however, also been benefited by prevailing weather conditions. In the large Eastern centers the buyers are numerous, and trade is expanding, but the same conservatism that has been noted on many occasions is still to be observed. The best reports of buying come from Chicago, St. Louis and Kansas City. Reports from the leading industries are not much changed. Iron and steel are quiet, and the demand for finished products shows no disposition to increase. Building operations continue to be active in many centers, and lumber and hardware are in better demand in the West and South. Foreign trade reports are still unsatisfactory. Imports for July exceeded exports, and for the seven months the excess of exports over imports was only $1,666,346, as compared with more than $66,000,000 a year ago. The exports of farm products are at low ebb, but this loss is made up in some degree by the increased exports of manufacturing products. The general better condition in the securities market has encouraged all lines of trade. It is believed that many large operations are simply waiting a favorable market upon which to float securities in order to begin making extensive improvements and additions. At the present moment there are no labor troubles which threaten to interfere with business. Collections continue to be only fair, but it is believed that after the crop is harvested and moved to market there will be no difficulty in this direction. Business failures for the week ended Aug. 18 as reported by *Bradstreet's* were 222 against 231 the previous week, 183 in like week of 1909, 236 in 1908, 153 in 1907 and 155 in 1906.

THE COPPER MARKET.

HIGH prices demanded by producers for electrolytic copper last week resulted in an extremely dull market. The selling companies have practically checked the demand of consumers both in this country and abroad. The melting of copper by consumers is close to what it was during the two preceding months, but new business is not coming in very rapidly, and extensions of electrical industries in the West are not particularly active. The dullness of demand, however, has had no effect upon the quotations at which producers are offering metal. The better report made for July by the Copper Producers' Association has done much to strengthen the market and encourage those who have for a long time been carrying large quantities of metal. It is generally believed that the curtailment of production which it is now admitted is fairly well started will eventually result in bringing the production of copper down to a basis but little in excess of the consumption. In the meantime it must be remembered that very large stocks are being carried both in this country and Europe by producers, speculators and consumers. In the monthly copper circular issued by the National Conduit & Cable Company, it is stated that there have been larger sales of copper and firmer conditions lately both in the local and foreign markets, partly as the result of the necessity of filling a moderate amount of new requirements, and partly from the impression produced by the talk of restricting production. "Continued over-production has kept the consuming trade," says the circular, "in a state of uncertainty for a long time. Manufacturers have been unable to state to what levels prices were liable to decline in consequence of the piling up of an enormous surplus in this country and at foreign points." Imports of copper continue to be fairly heavy, and exports are about at the rate of the two preceding summer months. For the present month up to and including Aug. 22 exports have been 20,027 tons. The daily call on the metal exchange Aug. 22 quoted standard copper as per accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.20	12.40	.....
August	12.20	12.40	12.30
September	12.20	12.40	12.30
October	12.20	12.40	12.30
November	12.20	12.40	12.30
December	12.20	12.40	12.30

The London market Aug. 22 was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	55 13 9	55 15 0
Standard copper, futures	56 11 3	56 11 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	11.70c
London, spot	£62 0 0	£52 15 0
London, futures	65 18 9	53 7 6
London, best selected	65 10 0	57 15 0

INDUSTRIAL AND COMMERCIAL NOTES.

Electrification on the Lackawanna.—A conference was held at Scranton last week upon the subject of electrifying what is known as the "pusher service" on the Delaware & Lackawanna Railroad. The conference was held in the office of T. S. Lloyd, the superintendent of motive power, and there were in attendance, besides Mr. Lloyd, S. S. Riegel, chief engineer, together with representatives of the Erie railroad, American Locomotive Company and the General Electric Company. Considering the heavy grades which the road has to contend with in that section, and at some points on the Buffalo division, the officials of the company have asked Mr. Lloyd to ascertain whether the electrifying of the road would mean a saving in operating expenses. The Erie representative was present to show how much that road had saved by the use of electric power under similar circumstances. While no result of the conference was given out, it is understood in Scranton that the directors will be informed that it would be cheaper to make a limited use of electricity. It is also said unofficially that within a year the Lackawanna from Scranton to Clark's Summit west, and from Scranton to Lehigh east, will be electrified This will take in two of the most hilly sections of the road.

Otis Elevator Company.—It is given out by officials of the company that the business of the Otis Elevator Company for the first six months of the current year is the largest in its history. Gross sales during that period were at a rate which would mean a business for the year of approximately $16,000,000. A feature of the business of the past six months which has given the officials of the company especial satisfaction has been the increase in the actual number of elevators sold. While the percentage in the total of the gross sales over 1909 has been large, it has not been nearly so great as the percentage of increase in the number of elevators ordered. The business has been a multiplicity of small orders. In order to take care of this increased business the company has been obliged to spend about $500,000 on its property this year. The company has about $7,000,000 working capital and its plant and real estate have recently been appraised at $14,000,000.

Maryland Telephone Company.—It is reported that the Chesapeake & Potomac Telephone Company will shortly discontinue operating the Maryland Telephone Company as a separate institution with distinct exchanges and service. Preparatory to carrying out this plan it is stated that the company will on Jan. 1 next retire the outstanding Maryland Telephone Company first mortgage 5 per cent bonds, of which the original issue was $1,000,000. It is said that the Bell interests, which control both companies, have been quietly buying up the bonds for some time, which would account for the recent strong demand for them.

Gas-Electric Cars in Texas.—The Gulf, Colorado & Santa Fe Railroad Company has ordered a number of gas-electric cars, to be operated after Sept. 1, on its Houston and Galveston line in competition with interurban service of the Galveston, Houston & Henderson Railway.

Crocker-Wheeler Sales.—The Crocker-Wheeler Company, Ampere, N. J., has recently sold the following apparatus: Two 600-kw direct-current turbo-type generators for connection to DeLaval turbines to the Iroquois Iron Company, of Chicago; one 400-kw direct-current turbo-type generator for the United States Finishing Company, of Connecticut; one 500-kw synchronous motor-generator set to the Tennessee Coal, Iron & Railroad Company, of Ensley, Ala.; a 200-kw direct-current generator with 200-amp balancer for the Mercantile Library Building, Cincinnati, Ohio; two 125-kw direct-current generators for the Kilburn Mills, New Bedford, Mass.; two 120-kva belted alternators to the Waterous Engine Company, Canada; a 250-kw engine-type direct-current generator for the Gleason Works, Rochester, N. Y.; one 300-kva engine-type alternator with exciter for the Great Lakes Engineering Works, Ashtabula Harbor, Ohio; one 350-kw generator for the Thomas G. Plant Company, of Boston, Mass.; one 750-kw direct-current generator for the Superior Steel Company, Pittsburgh, Pa.; two 150-kw direct-current generators for Ohio Fuel & Supply Company; 3460 hp in direct-current rolling-mill motors for the American Sheet & Tin Plate Company, of Indiana; one 200-kva engine-type alternating-current generator for Crown Mills, of New York; 235 hp in direct-current motors for crane service in the Central Furnace Plant of the American Steel & Wire Company, of Ohio; one 500-kva engine-type alternating-current generator for the Lynn Building Trust, of Lynn, Mass.; one 375-hp motor to drive an Ingersoll air compressor in the works of the Bethlehem Steel Company, and three 250-kw generators with two 350-amp balancers for the Utah Hotel, Salt Lake City, Utah.

Eastern Tennessee Power Company.—Messrs. J. G. White & Company, of New York, have been awarded the contract for the complete engineering and construction of a hydroelectric station for the Eastern Tennessee Power Company. The dam and station will be erected on the Ocoee River at Parksville, 12 miles from Cleveland, Tenn. The dam will be of cyclopean concrete 780 ft. long on the crest, 450 ft. being provided for overflow and 350 ft. non-overflow. The overflow portion will be 110 ft. high above mean water and will be equipped with flashboards and the necessary sluices. The non-overflow portion of the dam will be about 13 ft. higher than the overflow portion and will accommodate the penstock intakes at the top and penstocks passing from the intakes to the turbines below. The generating station will be located on the down-stream side of the dam and will be an integral part of the non-overflow portion of that structure. The substructure will be of concrete with a steel and masonry superstructure. The equipment will consist of four main units having a normal rating of 3000 kw each; one 200-kw exciter unit, step-up transformers and switching apparatus. Each main unit will comprise one tandem horizontal turbine in enclosed case directly connected to a three-phase, 60-cycle generator. Each generator will have an exciter mounted on its shaft. A tail-race will be excavated for some distance down stream and will, if necessary, be separated from the main river channel by a timber crib or by a concrete wall. The shore of the river adjacent to the power house will, if necessary, be protected by rip-rap. The estimated cost of the entire development is placed at approximately $2,000,000.

Probable Turbine Order.—An English electrical contemporary comments as follows on an item which recently appeared in these columns: The *Electrical World* states that Mr. C. M. Shaw, city electrical engineer of Worcester, is to pay a visit to the United States in August and September, and asks manufacturers to send him particulars of "up-to-date turbine plants and umbrella-type alternators," for a head of 10-13 ft. and of 150-600 hp, as well as of the latest domestic electrical appliances (not for lighting). The probability that Mr. Shaw will place a large order with our American competitors should prove a valuable stimulus to their jaded energies, and afford them an opportunity of renewing that invasion which for some reason or other seems to have lain in abeyance for the last decade. It is time for England to wake up!

Citizens' Light, Heat & Power Company.—General Manager P. R. Whiting of the Citizens' Light, Heat & Power Company, Montgomery, Ala., in a circular letter regarding the status of ownership suit, says that the company has been advised by its attorneys that the only effect of the temporary injunction granted by Judge Jones is to maintain the existing status relating to the possession of the stock of the Citizens' company, and to keep the matter in court pending a final hearing and decision after submission of the facts. The decision rendered is only based on demurrers filed to the bills and does not go into the merits of the controversy or indicate in any way what the final decision of the court will be. On the belief that the ownership of the property will eventually be found to belong to R. Tillis, chief owner of the Montgomery Traction Company, a contract, it is announced, has been given to Messrs. J. G. White & Company, of New York, for extensions and improvements costing in the neighborhood of $500,000. These improvements include two large steam turbines with a combined output of 8000 hp, several boilers, switching apparatus and other devices required in connection with the operation of the plant. This equipment when installed will give the company a capacity of 100,000 hp.

Crude Rubber Prices.—There have been wide fluctuations in the market prices for crude rubber during the past few weeks and the result has been that most of the manufacturers of rubber goods and of insulated wire have refrained from buying. It is believed by the users of rubber that the present fluctuations are due to manipulation and do not have any connection with supply and demand. One manufacturer says that the market is apathetic and that buyers do not care to take advantage of declines and certainly will not buy upon advances. Ever since crude rubber sold at $3 a pound for Para the manufacturers have been loth to purchase. When the price declined to $1.75 on Aug. 9, which is the low point for the year, the manufacturers were still unwilling to take hold. Quotations Aug. 22 were $2.12@2.17 a pound. During the past week the fluctuations have been so wide that the market is more or less demoralized. While the manufacturers are not complaining of hard times, they do not deny that sales by the larger rubber companies have fallen off during the past month. This is in spite of the fact that the automobile dealers declare that this will be the record year in the automobile industry.

Automatic Telephone in Chicago.—It is given out that on Oct. 1 the Automatic Telephone Company, a subsidiary of the Chicago Subway Company, will open its service to the public, with considerably more than the 20,000 subscribers required by the ordinance. It is anticipated that before April 1 the company will have 30,000 subscribers. Of the $3,500,000 receiver's certificates of the Chicago Subway Company last spring, all but $500,000, which has been held in reserve, has been spent upon the construction of the telephone system. Nothing is being done at the present time toward the reorganization of the Illinois Tunnel Company or the Subway company. All plans looking to this have been held up pending the completion of the telephone system, when it is believed the combined properties will show earnings sufficient to at least pay operating expenses.

New Automobile Industry for Canada.—The United Motors, Ltd., with a capital of $200,000, has decided to locate at Welland, Ontario, giving employment to 100 hands. The buildings will be fireproof, and will be erected at the junction of the Michigan Central and Grand Trunk railways, with switches to the T., H. & B., affording ample shipping facilities It is proposed to build 300 motor cars for next season. The provisional directors are: Frederick Sager, of Detroit; Willis L. Adams, Niagara Falls, N. Y.; E. A. English, Toronto; L. C. Raymond and B. J. McCormick, of Welland, Ont.

Mexican Order for Westinghouse Company.—The Westinghouse Electric & Manufacturing Company has recently received an order from La Blanca & Anexas Mining Company for 40 type MS motors, to be used in the company's mill at Pachuca, Mex. The motors ordered range in size from 5 hp on the pulp thickeners to 75 hp on the tube mills. The order also includes seven 250 kva O. I. S. C. transformers and one 12-panel switchboard.

Automobile Driving Lamps.—C. A. Vandervell & Company, Warper Way, Acton Vale, London, England, ask us to say that a type of double-ended holders for automobile lamps recently described in these pages as something new has been made by them for some years under British patents. Protection under U. S. patents was not, however, applied for.

The Electrose Manufacturing Company, Brooklyn, is making considerable extensions to its plant. With its present equipment it has been found necessary to work overtime, but with the facilities now being added orders can be handled with greater promptness.

McCall Ferry-Baltimore Transmission Line.—The Pennsylvania Water & Power Company announces that it has secured all of the rights of way for the pole line which is to bring electrical energy from McCall Ferry to Baltimore. The way for the entire distance is 100 ft. wide and the length of the pole line is 45 miles. Workmen are now engaged in placing the towers which will support the wires along the route from the plant to Baltimore, and it is thought that the line will be ready for distribution in Baltimore and vicinity about Nov. 1. One of the first installations will be for the supplying of light and power for the Consolidated Cotton Duck Company in Woodberry and Mount Vernon.

Bids for Naval Academy Power Plant.—Bids will be received until Oct. 1 for a complete equipment for the new power plant of the United States Naval Academy, Annapolis, Md. The work includes the transfer of a portion of the equipment from the old power house, furnishing new equipment, lighting the power house, new switchboard and connections to outside service. Plans and specifications may be obtained from the superintendent of the Naval Academy upon deposit of $10 for their return.

Financial.

THE WEEK IN WALL STREET.

SENTIMENT in Wall Street during the past week was the most optimistic that has been observed in the financial district for many months. There was a general happy expression on the faces of traders and even commission houses begin to feel that they may again earn money. Stocks for the most part showed considerable advance, and in some cases the gains were very pronounced. The advances from the low points of the early summer are sufficient to make glad all those who had the courage to buy in the days of depression. Although the movement in price was somewhat irregular, and the close of the week was not at the highest point, this fact did not offer any element of discouragement. Conflicting factions were struggling throughout the entire period, and every considerable advance was followed by profit taking, which brought about a reaction. There was considerable evidence during the week that some master hand or some clique of important interests were engaged in manipulation. At times there would suddenly appear large buying orders for half a dozen issues, and pools sprang up in many of the cheap industrials, and were able to secure advances on several points. Rumor in Wall Street attributed the most important of these manipulative movements to a group of large bankers. It was said that this group was especially interested with Lehigh Valley, Missouri Pacific and Chesapeake & Ohio. There was also considerable activity in Rock Island and in Denver & Rio Grande, common. The ability of New York State to sell 4 per cent canal bonds at 101¾ indicates that the investment situation is not as bad as had been believed. Many of the more conservative houses in the Street are earnestly advising their customers to purchase good bonds at the present levels. The money market continues to be extremely easy, and the bank statement shows large quantities of cash available for borrowers. While the price of sterling exchange does not at the moment warrant gold imports, this fact does not interfere with the easy condition of the money market. Quotations Aug. 22 were: Call, 1¼@1½ per cent; 90 days, 3½@3¾ per cent. The quotations in the table are those of the close of Aug. 22.

NEW YORK.

	Aug. 15.	Aug. 22.	Shares sold.		Aug. 15.	Aug. 22.	Shares sold.
All.-Ch.	9¼	9	500	Int.-Met., pfd	37⅛	48	19,033
All. Ch., pfd.	35	33	400	Mackay Cos..	85¾	87*	700
Amal. Cop...	65⅝	64⅞	90,225	Mackay C.,pf.	72¾	73¾*	300
Am. D. T...	20½*	20½*	———	Man. Elev...	128	130⅛*	100
Am. Loc.....	37½	34½	2,410	Met. St. Ry..	15*	15*	———
Am.Loco.,pfd.	104	103½*	100	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	71	71½*	———	Steel, com...	70½	69¾	531,500
Am. T. & T..	135	134½	6,525	Steel, pfd....	116	116¼	3,661
B. R. T.....	76½	75½	22,680	W. U. T.....	63	61	1,350
Gen. Elec....	143	144	800	West'h., com.	58	59½*	4,200
Int.-Met.	17	17¾	23,500	West'h., pfd.	110	110*	———

PHILADELPHIA.

	Aug. 15.	Aug. 22.		Aug. 15.	Aug. 22.
Am. Rys.....	41	44	Phila. Elec.....	15⅝	15
Elec. Co. of A.....	11⅜	11⅜*	Phila. R. T.....	19½	18¼
Elec. St. B'ty.....	49	49⅞	Phila. Trac.....	82⅝*	82¾*
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	45⅛	43½

CHICAGO.

	Aug. 15.	Aug. 22.		Aug. 15.	Aug. 22.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	118	117*
Chi. Rs., Ser. 1.....	70	70	Met. El. Co.....	———	15*
Chi. Rs., Ser. 2.....	16½	16⅜	Met. El., pfd.....	———	60*
Com. Edison.....	110	111	Nat'l Carbon.....	———	120*
Chi. Subways.....	6	5¼	Nat'l Car., pfd.....	117	117*

BOSTON.

	Aug. 15.	Aug. 22.		Aug. 15.	Aug. 22.
Am. T. & T.....	133¾	134¾	Mex. Tel.....	5⅞	5¾*
Cum. Tel.....	———	142½*	Mex. Tel., pfd.....	6¼	6¼*
Edison E., Ill.....	257	258½	N. E. Tel.....	130	130
Gen. Elec.....	144	144	W. T. & T.....	15	15*
Mass. E. Ry.....	16¼	17¼	W. T. & T., pfd....	84	85*
Mass. E. Ry., pfd..	81½	82¾*			

*Last price quoted.
Shares sold for week Aug. 15 to Aug. 20.

FINANCIAL NOTES.

Hudson River Power Reorganization.—In a circular letter to bondholders, Mr. James R. Hooper, chairman of the protective committee of bondholders of the Hudson River Electric Power Company and its seven affiliated companies, states that of the total Hudson River issues, amounting to $11,009,000, the company has added to its various depositaries $7,702,000. Of the three principal issues there are $2,819,000 of Hudson River Electric Company; $3,352,000 of the Hudson River Electric Power Company, and $1,069,000 of the Hudson River Water Power Company. The first draft of the plan for reorganization has been submitted to the Public Service Commission of the Second District, because it is necessary for the company to obtain the approval of the commission to any proposed plan before its issuance to depositing bondholders. Messrs. Stone & Webster, Boston, have been working for the past two months preparing an inventory and appraisement of the company's holdings. The company's attorneys are making up their records of foreclosure proceedings of the 11 major and a large number of minor mortgages, having compiled thus far six large volumes.

Chester County Electric Company to be Sold at Auction.—The Chester County Electric Company, of Avondale, Pa., having failed to pay the Central Trust & Savings Company of Philadelphia $204,606, as required under a decree handed down by Chancellor Curtis, all the property of the company will be sold at public auction on Sept. 1. The trust company is the trustee of $190,000 of first mortgage bonds of the electric company and the Chester County Electric Company defaulted in the payment of the interest on these bonds; the interest amounts to nearly $15,000. The sale will be held at 11 a. m. Sept. 1 at the County Court House in Wilmington, Del., and will be conducted by Mr. William M. Hope, of Dover, receiver for the company. The company operates three plants and supplies electrical energy to the towns of Kennett Square, Avondale, West Grove, Toughkenamon, Chatham, Kemblesville, New London, Strickerville and Landenburg, Pa., besides Little Baltimore and Hockessin, Del.

Consolidation in New Mexico.—A telegram has been received from George W. York, Roswell, N. M., announcing the consolidation of the Roswell Gas Company and the Roswell Electric Light Company, the combination to be known as the Roswell Gas & Electric Company. The president of the new company will be L. K. McGaffey, of Roswell; secretary and treasurer, George W. York, Cleveland, Ohio, and general manager, D. W. Low. The consolidation was effected by Otis & Hough, of Cleveland, who are also interested in the Michigan Power Company, Lansing, and the Alliance (Ohio) Gas & Power Company. W. D. Sweet will be retained as local manager of the company.

Consolidation in Upper Ohio Valley.—It is said that a holding company has recently been formed under the laws of Pennsylvania, with a capital of $1,500,000, to take possession of the lighting and power franchises of the upper Ohio and Beaver Valleys. The principal properties to be taken over will be the Steubenville-East Liverpool Railway & Light Company and the East Liverpool Traction & Light Company. Of both of these companies Van Horn Ely is president, and it is announced that he will be the president and general manager of the new holding company. No announcement has yet been made of the properties that will be included in the deal.

Springfield (Ill.) & Jacksonville Electric Railway.—H. H. Randolph & Company, of Chicago, are offering $800,000 6 per cent bonds of the Springfield & Jacksonville Electric Railway Company at 97½. These bonds will provide for the entire construction cost of the line between the two terminals, a distance of 34 miles. Work has already begun.

Chicago Consolidated Traction.—The merger ordinance for the franchise for the consolidation of the Chicago Railways Company and the Chicago Consolidation Traction Company has been introduced in the Chicago City Council and it is said is favorably considered by the transportation committee of that body. It is believed that the franchise will be passed next week and that the rehabilitation of the Consolidated Traction property will be commenced at once. Most of the material is at hand or available and it is said that work will be begun the instant the franchise ordinance is signed. President Roach, of the Railways company, says track laying will be rushed, possibly at the rate of two and a half miles a week. Between 3000 and 5000 men will be employed and probably $2,500,000 will be expended before winter. Under its 154 franchises the Consolidated company has 185 miles of track. Of this 128 miles is in the city of Chicago and about 60 miles of this track will be entirely rebuilt. It is intended also to install 250 large cars this fall.

Bullock Public Service Company.—A consolidation of the managements of a number of small central stations companies in Eastern Nebraska and Western Iowa has been brought about by Mr. E. A. Bullock, of Norfolk, Neb., who for a number of years past has been president of the Norfolk Electric Light & Power Company, and is an ex-president of the Nebraska Electrical Association. He has organized the Bullock Public Service Company with offices at 515 Brandeis Theater Building, Omaha, Neb. The companies controlled are the Norfolk (Neb.) Electric Light & Power Company, Blair (Neb.) Electric Light & Power Company, Beatrice (Neb.) Electric Company and Missouri Valley (Ia.) Electric Light Company. A recent item in our construction news stating that the York, Neb., plant had been purchased by this company, was an error.

Commonwealth Edison Company.—The gross earnings of the Commonwealth Edison Company of Chicago for the first ten months of the current fiscal year are running 20 per cent ahead of last year. Estimated gross for the year ending Sept. 30 is over $12,000,000, as compared with actual gross of $10,639,446 last year. The increase of net is less than that of gross on account of the increased cost of fuel and labor. The subsidiary companies are expected to show proportionate increases. The North Shore Edison Company has done more business for the first ten months of this year than for all of last year. It is understood that 80 per cent of the $5,000,000 of Chicago Edison bonds were exchanged for Commonwealth Edison Company bonds before the right to exchange expired on Aug. 15.

Canadian Light & Power Company.—The annual meeting of the Canadian Light & Power Company was held at Montreal on Aug. 12. The particulars of the physical development were given and the shareholders expressed general satisfaction with the present condition of the company. Construction work is well advanced and well within the estimates of the company's engineers. It is expected that power will be turned on about Jan. 1 next. The old board of directors was re-elected as follows: F. Howard Wilson, president; E. A. Robert, vice-president; George G. Foster, K. C.; N. Curry, J. M. Wilson, William C. Finley, J. W. McConnell, R. N. Smyth and F. J. Shaw. The capital of the company is $6,000,000, with a bond issue of $4,000,000.

Sale of Phonograph Company.—The property and all franchises and rights of the Edison-Bell Consolidated Phonograph Company of London will be sold at auction in New York, Sept. 1, to satisfy a judgment and foreclosure obtained by the Guaranty Trust Company. The action was brought to satisfy a lien against the company of $443,606, with 6 per cent interest from June 27, 1910. Included in the sale is the right, title and interest of the Edison United Phonograph Company in the German company in Cologne and to the proceeds of the sale of phonographs stored in New York; also 2,500 shares of the capital stock of the Edison United Phonograph Company of the par value of $250,000, and 45,000 shares of the International Graphophone Company of the par value of $4,500,500.

East St. Louis (Ill.) Light & Power Merger.—This company was incorporated under the laws of the State of Illinois with $1,000,000 of authorized capital stock in $100 shares, of which the East St. Louis & Suburban Company owns the entire outstanding amount of $733,500. The company will control the East St. Louis Light & Power Company, organized in 1909 and possessing a 99-year franchise; the Citizens Electric Light & Power Company, and the Southwestern Light & Power Company. The officers are as follows: President, Mr. L. C. Haynes; secretary and treasurer, Mr. G. L. Estabrook. No bonds have been authorized yet. The company purchases its electricity from the East St. Louis & Suburban Railway Company.

California Utility Merger.—The Long Beach (Cal.) Consolidated Gas Company has been incorporated under the laws of California with an authorized capital stock of $1,500,000 to carry out a plan for merging on the basis of 37 per cent and 63 per cent respectively the properties of the Inner Harbor Gas Company and the Southern California Edison Company in the city of Long Beach. The new company proposes to issue $1,000,000 in bonds.

Forty-second Street Railway Sale.—The United States Circuit Court has signed an order postponing the sale and foreclosure proceedings of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company from Sept. 1 until Oct. 18. This foreclosure sale is on a judgment upon the mortgage held by the Union Trust Company to secure a sum of $1,600,000 in bonds.

Ontario Power Company.—The general balance sheet of the Ontario Power Company, of Niagara Falls, including the Ontario Transmission Company, as of July 31, 1910, shows total assets of $19,053,986. The new conduit which was opened July 25, it is said, will more than double the power already developed by the company.

DIVIDENDS.

American Railways Company, quarterly 1½ per cent, payable Sept. 1.

Brockton & Plymouth Street Railway Company, preferred, semi-annual, $3 per share, payable Sept. 15.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable Oct. 1.

Brooklyn Union Gas Company, quarterly, 1½ per cent, payable Oct. 1.

Elmira Water, Light & Railway Company, preferred, semi-annual, 2½ per cent, payable Sept. 1.

Federal Mining & Smelting Company, preferred, quarterly, 1¾ per cent, payable Sept. 15.

Gas & Electric Securities Company, preferred, initial monthly, 7/12 per cent.

Manufactured Rubber Company, preferred, quarterly, payable Sept. 1.

New York & Queens Electric Light & Power Company, preferred, quarterly, 1¼ per cent, payable Sept. 1.

Susquehanna Railway, Light & Power Company, preferred, semi-annual, 2½ per cent, payable Sept. 1.

Underground Electric Railways Company, Ltd., London, ½ per cent on income bonds.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Light & Traction Company:					
July, 1910	$250,723	$10,669	$240,054	.....	.....
July, 1909	234,101	9,403	224,698	.....	.....
Brooklyn Rapid Transit Company:					
Year ended June 30, 1910	20,906,930	11,726,392	9,180,538	7,108,369	2,611,595
Year ended June 30, 1909	19,694,462	11,394,655	8,299,807	6,969,015	1,936,609
Montreal Street Railway Company:					
July, 1910	398,847	215,224	183,623	69,259	114,372
July, 1909	345,573	177,412	168,161	52,883	115,278
Nashville Railway & Light Company:					
July, 1910	144,547	84,134	60,414	37,708	22,706
July, 1909	140,886	85,574	55,339	37,220	18,118
Ontario Power Company:					
July, 1910	57,225	11,638	45,587	47,462	4,412
July, 1909	47,144	9,526	37,618	26,991	11,094
Washington, Baltimore & Annapolis Electric Railway Company:					
July, 1910	57,202	28,393	28,809	.....	.....
July, 1909	54,403	23,439	21,054	.....	.....

General News

Construction News.

ANNISTON, ALA.—The entire system of the Southern Bell Telephone Company in this city is being overhauled. All of the old wires are to be taken down and over 8000 ft. of new cables installed.

MONTGOMERY, ALA.—The Citizens' Light, Heat & Power Company, Montgomery, Ala., which has recently closed a $500,000 contract for the engineering and construction work required for additional facilities, is also planning an extension of its transmission lines which will represent an expenditure of between $100,000 and $200,000.

TUSCUMBIA, ALA.—A movement has been started by local citizens for the construction of an electric light plant in Tuscumbia. A subscription of $25,000 is now being taken for this purpose. The Sheffield Company, of Sheffield, Ala., furnishes electrical service in this place.

PHOENIX, ARIZ.—Sealed proposals will be received by Charles W. Goodman, superintendent Indian school, Phoenix, Ariz., for furnishing and delivering at the school 1150 electric lamps, cord, wire, taps, etc., during the fiscal year ending June 30, 1911.

PHOENIX, ARIZ.—The stockholders of the Salt River Valley Water Users' Association have declared in favor of a land tax of $900,000, the proceeds to be used for the construction of three power plants and canal extensions, plans for which are being prepared by Louis C. Hill, engineer of the United States Reclamation Service. The association proposes power plants on sites already selected for them on the Salt River, below the Roosevelt dam, where it is estimated that 18,000 hp can be developed. Other sites are available which will increase the total development to 25,000 hp.

HAMBURG, ARK.—Bids will be received by the Board of Improvement, District No. 2, of Hamburg, Ark., until Aug. 31 for furnishing materials, machinery and construction on electric light plant and waterworks system for the city of Hamburg, in accordance with plans and specifications which are on file at the office of the Board and at the office of Willis E. Ayres, engineer, 370 Randolph Building, Memphis, Tenn. W. L. Blanks is chairman of board.

ALLEGHENY, CAL.—It is expected that the substation of the Middle Yuba Hydro-Electric Company now under construction in the Buckeye Diggins, near Smith's Flats, will be ready to supply electricity throughout Allegheny by Sept. 15. The company is reconstructing the road on the Lafayette ridge between the Croesus mill and the Plumbago mine in order to facilitate the transportation of material for the new plant in American Hill, which it is estimated will take two years to complete. In the meantime the company will secure power from the Pike City plant.

LONG BEACH, CAL.—Plans have been prepared by H. W. Dennis, chief engineer of the Southern California Edison Company, for a portion of the work in connection with the erection of the steam generating station at Long Beach. The cost of the work is estimated at $125,000 and will include the foundations for the buildings and machinery, salt water intake and adjacent retaining wall, intake conduit, discharge conduit and protecting structure. One portion of the building will be 82 x 221 ft. and the other 145 x 72 ft. The conduit will be 900 ft. long, 6½ x 6 ft., built of concrete. The concrete retaining wall will be 218 ft. long with a 10-ft. base, 10 ft. high and 14 in. thick.

LOS ANGELES, CAL.—Bids will be received by the Board of Supervisors until Aug. 29 for furnishing necessary equipment and electricity for lighting certain streets in Sheridan lighting district, and the Manhattan Beach lighting district. C. G. Keyes is county clerk.

NEEDLES, CAL.—The Board of County Supervisors has granted the petition of the citizens of Needles for an election to be held in September to vote on the question of establishing a lighting district in this city. The supervisors have also granted similar petitions presented by the citizens of Highland and Ralto.

PASADENA, CAL.—The City Council is contemplating extending the municipal electric light system to parts of the city not having electrical service. The city clerk has been authorized by the lighting committee to call for bids for an auxiliary boiler for the municipal electric light plant. C. W. Koiner is general manager of the plant.

POMONA, CAL.—J. M. Paige, superintendent of parks, has been instructed by the trustees to make investigations in regard to the cost of installing a lighting system in Ganesha Park.

SACRAMENTO, CAL.—The South Sacramento Power Company, recently incorporated, proposes to furnish electricity for lighting and for operating pumping plants and industrial plants in all the territory of Sacramento County, south of Oak Park and Sacramento City down to Courtland. The company will purchase energy from the Great Western Power Company. Work has already commenced on erection of the distributing system. H. W. Conger, Fred Ferheart, Robert Lewis, F. L. Holland, A. L. Darrow, J. Govan, George J. Bryte, E. A. Nicholas, E. L. Southworth and Joseph Shaw are interested in the company.

SAN DIEGO, CAL.—At an election held Aug. 10 the proposition to issue $1,250,000 in bonds for establishing municipal gas and electric plants was defeated by a large majority.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has commenced work on the construction of a large gas plant in San Diego. The company is also contemplating the installation of a new electric generator, turbine type, with high power engines and new boiler in its electric power plant.

SAN FRANCISCO, CAL.—Preparations are being made by the Great Western Power Company to install an additional 10,000-hp unit in its plant. The company is said to have placed contracts for the entire output of its plant and is obliged to increase the equipment of power stations to meet the demands for service. Up to the present time, it is said, the company has placed contracts for nearly 50,000 hp.

RIDGEWAY, COL.—The electric light franchise recently granted to A. V. Walther by the Town of Ridgeway has been extended and taken over by a new company.

WILMINGTON, DEL.—The Chester County Electric Company, having failed to pay to the Central Trust & Saving Company, of Philadelphia, Pa., $204,606 in a specified time, as required under a decree handed down by Chancellor Curtis, all the property of the company will be sold at a public sale on Sept. 1. The company owns and operates plants in Delaware and in Chester County, Pennsylvania.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until Aug. 29 for equipping with electrical apparatus, switchboards, wiring, piping and carpenter work on the physics laboratory of the Business High School, located on Rhode Island Avenue, between Eighth and Ninth Streets, Northwest, Washington, D. C. Form of proposal, specifications and other information may be obtained upon application to the property clerk, District of Columbia, Room 320, District Building, Washington, D. C. John A. Johnston, E. M. Markham, acting commissioners.

ST. AUGUSTINE, FLA.—Extensive improvements are contemplated by the St. Johns Light & Power Company to its electric light, power and street railway systems, which will include the installation of additional machinery at the power plant, installing an electric motor at the drawbridge and rebuilding its tracks with heavier rails.

ATLANTA, GA.—The finance and electric light committees of the Council have voted to recommend to the Council the acceptance of the plan for a "Great White Way," on Mitchell Street from the terminal station to Whitehall Street, on Whitehall from Mitchell Street to the viaduct and on Peachtree Street from the Viaduct to Ellis Street, submitted by George A. Miller representing the Flour City Ornamental Iron Works, of Minneapolis, Minn. The plan calls for the erection of 125 Corinthian standards, 70 feet apart along the entire route, each standard carrying five lamps. The cost of maintaining the system is estimated at $45 per year for each standard, the lamps burning from dusk to midnight. Property owners along the route have agreed to pay for the cost of the installation providing the city would maintain them. It is expected that the Council will adopt the recommendation and work will commence on the installation of the system at once.

BERRYTON, GA.—Arrangements are being made by the owners of the Berryton Mills to remodel the buildings of the former Racoon Mills and install 5000 spindles and knitting machinery. The company proposes to construct a dam to develop water power. A generator will be installed to supply electricity for lamps. For further information address John M. Berry, of Rome, Ga., president.

MONTICELLO, GA.—The Jasper Cotton Mills, recently organized, is making preparations for the construction of a mill with a capacity of 10,000 spindles, equipped for electric motor drive. It is understood that the committee is ready to place contracts for machinery. The company is capitalized at $20,000. For further information address L. O. Benton.

CAPRON, ILL.—Investigations are being made in Capron by Edward J. Dunn, superintendent of the Harvard Light & Power Company, of Harvard, Ill., with a view of extending its transmission lines to this village. The Village Board is considering the installation of street lamps. It is understood that if sufficient patronage is guaranteed the company will extend its system from Chemung to Capron within the next two months.

CHICAGO, ILL.—It is reported that a final agreement has been reached between representatives of the city and the Sanitary District for the lighting of the streets by the district, the transfer to the latter of all municipal street lighting equipment and the addition of 10,000 street lamps in the next three years.

ROCK ISLAND, ILL.—It is reported that work has commenced on the construction of the new power plant of the People's Power Company. The equipment of the station will include a steam turbo-generator set with a rating of 900 kw and four water tube boilers, rated at 600 hp each.

GREENFIELD, IND.—Bids will be received by the Common Coun-

cil of Greenfield, Ind., until Sept. 6 for one 150 to 175-hp engine and one 150-kw generator, specification for which can be secured on application. Ora Myers is Mayor.

MUNCIE, IND.—Preparations are being made by the Muncie Electric Light Company, which recently purchased the electric light and power plant at Dunkirk and Hartford City, to extend its service to Redkey.

DES MOINES, IA.—Bids are being received by the Coliseum Company for the installation of an electric light plant in the Coliseum. The plant will supply electricity for lighting the building and for a large electric sign to be erected on the Locust Street side of the convention hall.

ELDORA, IA.—Application has been made to the Council by E. H. Lundy for a franchise to install an electric light plant in Eldora. If granted a franchise Mr. Lundy agrees to erect a concrete dam, at a cost of $10,000, and install a new power plant.

ELDORA, IA.—A syndicate has been formed by local business men for the purpose of erecting a large hydroelectric power plant on the Iowa River, near Eldora. It is proposed to build a large concrete dam on the site of the old mill, near here. The new power house will be equipped with a steam auxiliary plant. Application will soon be made for a franchise in Eldora.

WEBSTER CITY, IA.—The Webster City Electric Light & Water Works, R. J. Mullins, superintendent, writes that it is at present installing 40 five-lamp electroliers in the business portion of the city.

BURLINGAME, KAN.—The city is remodeling the municipal electric plant. When completed a day service will be established and electricity furnished to the mines. Prof. B. F. Eyer, of the State Agriculture College, is consulting engineer.

NATIONAL MILITARY HOME, KAN.—Sealed proposals will be received at the office of the treasurer of the western branch, National Home Disabled Volunteer Soldiers, National Military Home, Kan., unt l Sept. 3 for furnishing and installing an electric elevator at the quartermaster's storehouse. Plans and specifications can be seen at the office of the quartermaster; specifications with blank proposals and other information can be secured upon application to W. W. Martin, treasurer.

OAKLEY, KAN.—Plans and specifications have been prepared by Burns & McDonnell, of Kansas City, Mo., consulting engineers, for water-works system and electric light plant in Oakley, to cost about $40,000. Bids will be received for construction of the plants as soon as the plans have been approved by the State Board of Health.

VIDALIA, LA.—Plans are being considered by the Town of Vidalia for improvements and extensions to its water-works system, including the installation of deep well pumps, etc. H. E. Burnham is manager.

ATHENS, MAINE.—It is reported that preliminary steps are being taken by the citizens of Athens and Skowhegan for organizing a company to construct a railway between these places. An appropriation of $15,000 has been voted in Athens. A committee composed of J. E. Chapman, F. B. Rollins, C. R. Oliver and others has been appointed to promote the project.

DEXTER, MAINE.—Work has commenced on the erection of the transmission line of the Central Maine Power Company, of Waterville, from Pittsfield to Dexter. It is expected to have the line completed by Sept. 15. When the new service is installed the company will establish a 24-hour service and supply electricity for manufacturing plants and other industries.

ANNAPOLIS, MD.—Bids will be received at the Navy Department, Washington, D. C., until Oct. 1 for completing power plant at the United States Naval Academy, Annapolis, Md. Plans and specifications can be obtained on application to the superintendent of the Naval Academy, Annapolis, Md. A deposit of $10 will be required to insure return of plans. Beekman Winthrop is acting secretary.

BALTIMORE, MD.—The Susquehanna Transmission Company of Maryland, which is constructing a pole transmission line through Baltimore and Harford counties, has applied to the County Commissioners for permission to cross certain county roads in Eleventh and Fourteenth districts. The company is a subsidiary of the Pennsylvania Water & Power Company, of McCall Ferry, Pa., and proposes to erect a pole transmission line from McCall Ferry, Pa., to Baltimore, Md.

FREDERICK, MD.—Preparations are being made by the Washington, Frederick & Gettysburg Railway Company for the extension of its railway from Thurmont to Emmittsburg and Gettysburg in the near future. The road from Frederick to Thurmont, now operated by steam, is being equipped for electrical operation.

BOSTON, MASS.—Orders have been placed by the Edison Electric Illuminating Company of Boston for a 15,000-kw turbo-alternator, to be placed in the L Street generating station at South Boston.

GLOUCESTER, MASS.—The Gloucester Electric Company is contemplating placing its wires in underground conduits on Main, Vincent and Duncan Streets and has petitioned the Council for permission to do the work. It will take several years to complete the work.

GREENFIELD, MASS.—It is stated that there is no foundation for the reports that are current to the effect that the Greenfield Electric Light & Power Company has been absorbed by he Connecticut River Power Company. Joseph W. Stevens, president of the company, and also president of the First National Bank, is quoted as saying that the local plant is not for sale.

LENOX, MASS.—The Rogers Electric Company has secured the contract for installing electric lamps in and about the grounds and driveway at the Highland House for W. B. O. Field. The company will also wire the gate house for electric light service. About 100,000 ft. of cable will be used in connection with the work.

NEW BEDFORD, MASS.—The State Board of Gas and Electric Light Commissioners has approved the application of the New Bedford Gas & Edison Light Company for an increase in capital stock to the amount of $215,000, the proceeds to be used for additions to plant and to take up floating indebtedness.

OXFORD, MASS.—Several of the mills in Oxford are reported to be contemplating installing electric motors as auxiliary power. The Edwin Bartlett Company, of North Oxford, has recently installed a 75-hp motor in the upper mill to be used during low water periods. Electricity will be supplied by the Webster & Southbridge Gas and Electric Company.

WESTFIELD, MASS.—Plans are being considered for extensions and improvements to the municipal electric and gas plants, bids for which will soon be asked. The cost of the work is estimated at $15,000 and will include the erection of a new building and the installation of new machinery. Improvements will be made to the gas plant, which will increase the output from 125,000 cu. ft. per day to 225,000 cu. ft.

MUSKEGON, MICH.—It is reported that the City Council will not give the bids of the Muskegon Traction & Lighting Company and the Grand Rapids-Muskegon Power Company further consideration. Both companies have asked for an extension of time in which to make their bids for furnishing service to the city. It is said that the Council is considering the installation of a municipal electric light plant.

ALEXANDRIA, MINN.—The City Council is considering the question of installing an additional generating unit in the municipal electric light plant, at a cost of about $4,000.

AURORA, MINN.—The Village Council is reported to have decided to install three blocks of ornamental standard lamps.

BRAINERD, MINN.—M. D. Stoner is reported to be considering the construction of a power plant 10 miles southeast of Brainerd, at a cost of about $300,000.

GAYLORD, MINN.—The Village Council is contemplating increasing the output of the municipal electric light plant next spring. It is proposed to install a 25-hp engine direct connected to a 15-kw, 220-volt generator. F. J. Hecht is superintendent.

NASHWAUK, MINN.—Preparations are being made by the village of Nashwauk for the installation of an ornamental electric illuminating system on Central Avenue for three blocks. Orders for poles and material have been placed with the St. Paul Electric Company, of St. Paul, Minn. Each standard will carry three lamps. George A. Lindsay, superintendent of the water and light department, will have charge of the work.

PINE RIVER, MINN.—It is reported that Charles E. Webber and Harry H. Hill will construct a dam and an electric light plant in Pine River, at a cost of about $6,000. C. E. Wood, of Minneapolis, Minn., will have charge of the work.

ST. PAUL, MINN.—It is reported that the controlling interest in the Northern Heating & Electric Company, of St. Paul, has been acquired by H. M. Byllesby & Company, of Chicago. The new owners expect to make many improvements and extensions in the system, and it is probable that connections will be established between the local plant and the water-power rights at Cannon Falls and Mankato.

SANDSTONE, MINN.—The Sandstone Telephone Company has been incorporated under the name of the Eastern Minnesota Telephone Company, and proposes to extend its telephone lines to Superior and Duluth.

CLEVELAND, MISS.—The local electric light and ice plant has been purchased by Nott & Ward, of Cleveland, and the Southern Coal Company, of Memphis, Tenn., both creditors of the company.

OSYKA, MISS.—It was voted by the citizens of this city on Aug. 16 to issue $20,000 of bonds, the proceeds of which are to be used for water-works and an electric light plant. It is stated that plans have been completed and contracts will be awarded as soon as the bonds have been disposed of.

OMAHA, NEB.—It is expected that bids will soon be called by the County Commissioners for electrical work on the new court house. Two electric elevators will probably be installed. The cost of the work, exclusive of the elevators, is estimated at $20,000.

VERDI, NEV.—It is reported that preparations are being made by the Truckee River General Electric Company for the construction of a large dam in the Truckee River, near Verdi, which will back up the water more than 2500 ft. above the dam and form a large lake, feed a canal more than 40 ft. wide, which will carry the entire flow of the river and empty into the stream again just below Verdi, where a large power plant will be erected.

PATERSON, N. J.—Contracts have been awarded for the installation of a light and power plant in the General Hospital. T. M. Thorpe, of Paterson, N. J., has secured the contract for the electric plant, for $5,690; Leslie Elliott & Company for two boilers, at $3,300.

BAYPORT, N. Y.—The South Shore Traction Company has purchased a site for its proposed power plant on Oakwood Avenue, Bayport.

BROOKLYN, N. Y.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until

Sept. 7 for furnishing and installing lighting fixtures in the post office building at Brooklyn, N. Y., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

FULTON, N. Y.—The Oswego River Power Transmission Company, represented by Eugene M. White, bid $2,000 for a franchise for the distribution of electricity through the streets of Fulton. The Common Council has adopted a resolution authorizing the Mayor to award the franchise to the successful bidder.

GOUVERNEUR, N. Y.—The Bell Telephone Company in this city is planning to overhaul its plant, and it is expected that much new equipment will be installed.

LANCASTER, N. Y.—The citizens of Cheektowaga are considering the question of installing electric lamps on Broadway through the town from the city line to the Village of Depew. A. A. Durringer, a member of the Town Board, is interested in the project.

CHARLOTTE, N. C.—A contract has been closed between the Globe Electric Company, of Charlotte, N. C., and John E. Schott, representative of the John W. Fries Company, of New York, N. Y., for equipping the company's humidifying systems for electrical operation. The Globe Electric Company has also secured contracts to equip the plant of the Peck Manufacturing Company, of Warrenton, for electric motor drive and the Clyde Cotton Mills, of Newton, to be operated by electricity.

NASHVILLE, N. C.—It is reported that the Parker & Whitaker Lumber Company is contemplating the installation of a generating unit in its saw-mill to supply electricity in connection with its plant and for lighting purposes.

NEWBERN, N. C.—Extensive improvements are contemplated by the Home Telephone & Telegraph Company to its system, including the installation of a new switchboard and copper toll service, the reconstruction of cable system, laying 5000 ft. of new cable and construction of direct lines to Goldsboro and Weldon, N. C.

SALISBURY, N. C.—The Hambly Manufacturing Company of Salisbury, N. C., has made arrangements with the Southern Power Company for electricity for operating its plant and for equipping its factory for electrical operation.

BOWMAN, N. D.—The installation of an electric light plant in Bowman is under consideration. C. M. Cleveland, of Wausau, Wis., is reported to be interested in the project and will apply for a franchise.

SCRANTON, N. D.—It is reported that Messrs. Wall, Hawkes and Gardner, of Glendive, Mont., are interested in a project to establish an electric light, power and heating plant in Scranton.

STROUD, N. D.—Preparations are being made by the Dakota Western Telephone Company for the erection of a two wire-circuit to Alexander, a distance of 37 miles.

ANTWERP, OHIO.—Extensive improvements and additions have been made to the local electric light plant owned by A. A. Pointer, including the installation of one 150-hp high pressure boiler, one 156-hp Erie City, four-valve engine, one 150-kw, one 70-kw, 2300-volt, 60-cycle generators, one double-panel switchboard complete, and one 25-lamp General Electric magnetite arc lamp outfit.

EAST LIVERPOOL, OHIO.—The East Liverpool Traction & Light Company has purchased a building at Yellow Creek, which will be remodeled and equipped as a power station.

MIDDLETOWN, OHIO.—The Construction Department of the Safety Insulated Wire & Cable Company, 114 Liberty Street, New York, N. Y., has been awarded a contract by the Middletown Gas & Electric Light Company for laying underground electrical conduits and installing cables in Middletown. The work will represent an expenditure of approximately $12,000, and it is expected that part of the system will be in operation by Sept. 1.

NEWARK, OHIO.—The Newark Telephone Company has been granted a 21-year franchise to install an automatic telephone system in Newark, Ohio.

SANDUSKY, OHIO.—Bids will be received by John Bing, director of public works, until Aug. 29 for lighting the streets, public parks and highways for a term of 10 years.

YOUNGSTOWN, O.—Bids will be received by the Clerk of the Board of Education until Sept. 19 for installing electric wiring in the South High School. W. N. Ashbaugh is the director of schools.

BARTLESVILLE, OKLA.—Preparations are being made by the Bartlesville Interurban Railway Company to supply electricity for commercial and domestic purposes. Orders have been placed by the company for equipment, for its plant, including a boiler, wires, poles, etc. H. Atkin, formerly superintendent of the electric plant at Atchison, Kan., will assume management of the local plant. J. J. Curl, of Bartlesville, is president and general manager of the company.

COQUILLE, ORE.—The electric plant of the Coquille River Electric Company is reported to have been totally destroyed by fire recently. The plant furnished electrical service in Coquille and Myrtle Point.

REDMOND, ORE.—The Odin Falls Power Company, which recently applied to the City Council for a franchise to supply electricity and water in Redmond, proposes to erect a power plant at Odin Falls and transmit electricity and pipe the water to this town.

REDMOND, ORE.—Application has been made to the City Council by the Crook County Water, Light & Power Company for a franchise to install a water-works system and an electric light and power plant. The company is developing a water power project at Cline Falls, 4 miles from Redmond.

SALEM, ORE.—The Capitol Heating & Lighting Company is reported to have been granted a permit to construct and operate a heating and lighting plant in Salem.

PANAMA.—Sealed bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Sept. 16 for furnishing and erecting machinery to operate the Stoney Gate valves for controlling the main culverts and machinery to operate the cylindrical culverts of the upper lock at Gatun and the Pedro Miguel Lock. Blanks and general information relating to this circular (No. 596) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La.; and 1086 North Point Street, San Francisco, Cal.; also from the U. S. Engineer offices in the following cities: Seattle, Wash.; Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburgh, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; Mobile, Ala.; and Galveston, Tex.; Commercial Club, Kansas City, Mo.; Chamber of Commerce, Quincy, Ill.; and Chamber of Commerce and Board of Trade, Tacoma, Wash. Captain F. C. Boggs is general purchasing officer.

CHAMBERSBURG, PA.—The construction of an electric railway from Chambersburg to Mercersburg, with a branch from St. Thomas to Edenville, is under consideration.

HOLLIDAYSBURG, PA.—Plans are being considered by the United Telephone Company for the installation of a new system in Hollidaysburg in the near future. The present system will be replaced with the common battery system.

McCALL FERRY, PA.—The machinery of the power plant of the Pennsylvania Water & Power Company at McCall Ferry has been put in operation to be tested. The plant will not be ready for operation for several months. When completed the plant will have an output of more than 100,000 hp.

McKEESPORT, PA.—Preparations are being made by the Pittsburg, McKeesport & Westmoreland Railway Company for the construction of a power house, 40 ft. x 40 ft., to be erected on a site adjoining its car house in Westmoreland County. The company now purchases electricity for operating its system from the West Penn Railways Company.

NEW BRIGHTON, PA.—Van Horne Ely, former president of the traction and lighting interests between East Liverpool and Steubenville, Ohio, has completed the construction of an electric and power system in the upper Ohio Valley, extending from Steubenville, Ohio, to Sewickley, Pa. A holding company is to be formed capitalized at $1,500,000. The lighting plants in this part of the Ohio Valley will remain in control of the Ohio Valley Scenic Railway Company, while those between Midland and Freedom, Pa., will be under the direction of the Beaver Valley Light & Power Company. Those further up the river will be held by the holding company, but will have one head. The main plant will be located at Ambridge, Pa., and substations in all other Ohio Valley towns. The main office is at New Brighton, Pa. Mr. Ely will be president and general manager of the company.

NORTH WALES, PA.—Preliminary surveys are being made for the proposed electric railway to connect the Philadelphia division of the Lehigh Valley Transit Company at this place with the Philadelphia & Western Railway Company at Villanova. E. B. Smith & Company, of Philadelphia, Pa., are reported to be interested in the project.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company has made arrangements with the Delaware County Electric Company and the Beacon Light Company, of Chester, subsidiary corporations of the Philadelphia Electric Company, to supply electricity for operating its railways in Delaware County.

PROVIDENCE, R. I.—F. E. Chester & Company are moving their manufacturing plant from Dudley Street to the factory recently purchased in Bellefonte and the output of the plant will be greatly increased. The new plant will be equipped for electric motor drive. Electricity for operating the plant will be supplied by the Narragansett Electric Lighting Company.

HIGHMORE, S. D.—The installation of an electric light plant in Highmore is reported to be under consideration.

PARKESVILLE, TENN.—J. G. White & Company, of New York, N. Y., have secured the contract for the complete engineering work and construction of a hydroelectric power plant for the Eastern Tennessee Power Company. The dam and power station will be located on the Oconee River, at Parkesville. The cost of the proposed plant is estimated at $2,000,000.

BRADY, TEX.—J. N. Paxton, of Abilene, Tex., is reported to have purchased the property of the Brady Telephone Company from George W. Vierling, for $30,000. The new owner, it is understood, will extend and enlarge the system.

FLATONIA, TEX.—A franchise has been granted to the owners of the proposed electric light plant and water-works system for a term of 50 years. The city has entered into a contract with the company for street lighting and also for furnishing electricity to light the court house.

LAREDO, TEX.—It is reported that preliminary steps have been taken toward the establishment of a large electric power plant on the Rio

Grande River, about 33 miles above Laredo, by a syndicate, of which H. A. Stucky is the head. The proposed plant will be located in a coal field embracing 45,000 acres, owned by Mr. Stucky and associates. Coal screenings will be used for fuel for the plant. The company will transmit electricity to Laredo, Carrizo Springs, Cotulla and to several towns and cities in Mexico.

FAIRMONT, VA.—Owing to the increased demand for electrical service the Fairmont & Clarksburg Traction Company is reported to be planning an addition to the Jayenne power plant. The equipment, it is said, will include two 1000-kw generators.

NORFOLK, VA.—The Southern Bell Telephone & Telegraph Company, Atlanta, Ga., is to install a $70,000 switchboard in the new exchange which it expects to build at Norfolk.

ANACORTES, WASH.—The Anacortes Water & Electric Company is installing a 400-kw Curtis steam turbo-generator set, with new switchboard and other apparatus. The company is planning to establish a 24-hour service and will supply electricity for manufacturing plants and other industries. The cost of the improvements is estimated at $16,000.

ELLENSBURG, WASH.—Extensive improvements are being made to the municipal electric light plant, including the installation of a 100-hp, Morgan-Smith water wheel and a 550-kw, 6600-volt, three-phase, 60-cycle generator. Contract has also been placed for a 300-hp water tube boiler, to be used as an auxiliary. E. L. Butler is superintendent.

SEATTLE, WASH.—The Board of Public Works has authorized the purchase of the street lighting system in Ballard from the Seattle Electric Company, at $5,629. The company held a contract for lighting the streets in Ballard before the consolidation, which was kept in force because the city, it was claimed, was unable to supply the service.

SPOKANE, WASH.—It is reported that J. J. Hill is interested in a project to construct an electric railway from a point near Spokane to Priest Lake.

STEVENSON, WASH.—It is reported that arrangements are being made by the Skamania Light & Power Company to extend its transmission lines to Carson immediately.

TOPPENISH, WASH.—Arrangements are being made by the Yakima Valley Telephone Company for the installation of a complete new telephone system in Toppenish.

WHEELING, W. VA.—Sealed proposals will be received until Sept. 27 at the U. S. Engineer office, Wheeling, W. Va., for construction of fireproof power house and chimney and installing two 115-hp boilers, two steam-driven air compressors, receivers, piping, etc., at dam No. 26, Ohio River. Bids will be considered on the entire plant, or for house and chimney and for different lots of machinery, etc. For further information address Captain F. W. Alstaetter.

SHEBOYGAN, WIS.—Preparations are being made by the Citizens Telephone Company for improvements to its system, which will involve an expenditure of from $8,000 to $10,000. A mile of cable will be erected between Sheboygan and Sheboygan Falls to provide for the increasing business in the rural districts.

SUN PRAIRIE, WIS.—At an election held recently bonds were voted to purchase the local electric light plant.

TOMAHAWK, WIS.—A new dam is being erected across the Wisconsin River, near Tomahawk, by the Bradley interests. The proposed plant will develop about 2000 hp.

EVANSTON, WYO.—Application has been filed with the State engineer by C. H. Solier, of Evanston, Wyo., appropriating 50 cu. ft. of water in the east fork of the Bear River in Summit County. The application states that it is proposed to develop from 300 to 600 hp at first, which will be increased later to 2000 hp. The plant will supply electricity in Evanston and other points in this locality.

FORT SASKATCHEWAN, ALTA., CAN.—Bids will be received until Sept. 1 by John Haddin, of Wetaskiwin, Alta., chief engineer for the John Galt Engineering Company, of Toronto, Ont., for water-power development in connection with the electric plant at Fort Saskatchewan.

STETTLER, ALTA., CAN.—Advices have been received from David Mitchell, city secretary-treasurer, that the proposed electric light plant recently reported will not be constructed this year.

ST. BONIFACE, MAN., CAN.—Bids will be received until Sept. 14 at the office of the Commissioners of the Transcontinental Railway at Ottawa (P. E. Ryan, secretary) for the wiring system required in connection with the locomotive shops of the National Transcontinental Railway east of Winnipeg. Bids will also be received at the same time and place for wiring ducts required in connection with the Transcontinental Railway shops east of Winnipeg. Address S. R. Poulin, district engineer, St. Boniface, Man.

BERLIN, ONT., CAN.—Contracts have been awarded by the People's Railway Company as follows: To F. W. Maxwell, Port Hope, Ont., for the construction of the 3-mile section of its proposed railway between Berlin and Bloomingdale on the main line to Guelph; to D. B. Campbell, of Latchford, Ont., for construction of road from Berlin to New Hamburg, a distance of about 14 miles. The Acme Construction Company is now grading between Bloomingdale and Guelph. Thomas Robbins, of Galt, has the contract for all the concrete work along the railway. Work will soon commence on the survey of the railway north from Guelph to Elora, Fergus and Arthur; also to complete the survey from Guelph to Hespeler and Puslinch Lake. When completed the company will have a direct route from the south partly over the Galt, Hespeler & Preston Railway to Guelph.

PORT CREDIT, ONT., CAN.—Sealed tenders will be received at the office of the Hydro-Electric Power Commission, Continental Life Building, Toronto, Ont., Can., until Aug. 29 for the construction of a transformer station building, near Port Credit, plans and specifications for which can be obtained at the above office. Hon. Adam Beck is chairman of the Commission.

TORONTO, ONT.—The contract for the construction of the new substation at the corner of Edwin and Ruskin Avenues has been awarded to Masonry, Teagle & Son, for $26,905.

TORONTO, ONT., CAN.—The Toronto Electric Company has set up a claim that the company under the terms of the agreement of 1889 is entitled to carry on business in any part of the city and contends that it is not limited as to area and has a right to operate in the territory annexed to the city since the agreement was made. The company now asks that the Board of Control remove the prohibition placed on its rights. If the board refuses to grant its request it is said that the company would test the claim in the courts.

New Industrial Companies.

THE AMERICAN AUTOMATIC BOILER FEEDER COMPANY, of Waterville, Maine, has been organized with a capital stock of $100,000 to manufacture and sell automatic boiler feeders, engines and other machinery, etc. G. W. Boynton is president and M. S. Goodrich, treasurer and clerk, both of Waterville, Maine.

THE AMERICAN ELECTRIC & MANUFACTURING COMPANY, of Hallowell, Maine, has been chartered with a capital stock of $50,000 for the purpose of doing a general manufacturing business, etc. The officers are: G. W. Boynton, of Waterville, Maine, president, and C. H. O'Brien, of Hallowell, Maine, treasurer.

THE AMERICAN HEAR-PHONE COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $10,000. The incorporators are: H. C. Shinnick, A. E. Coy and H. Schmidt, of Chicago, Ill.

THE AMERICAN ROTARY ENGINE MACHINE COMPANY, of Hartford, Conn., has been incorporated to take over all American patent rights of the Von Pittler system of rotary engines. A. K. Baylor, of New York, N. Y., is president and treasurer; E. M. Sawtelle, of Englewood, N. J., vice-president, and W. Baylor, of New York, N. Y., secretary. The executive offices of the company are at 103 Park Avenue, New York, N. Y.

THE COLLINS GEAR & MOTOR COMPANY has filed articles of incorporation with the Secretary of State at Dover, Del. The company is capitalized at $250,000 and the incorporators are: F. R. Hansell, of Philadelphia, Pa.; E. T. Vennel and G. H. B. Martin, of Camden, N. J.

THE ELECTRO-CHEMICAL RUBBER & MANUFACTURING COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $200,000 for the purpose of manufacturing electric motors, dynamos, electrical machinery, etc. The incorporators are: L. Daft, of Rutherford, N. J.; A. H. Martin, of Short Hills, N. J.; C. E. Haydock and W. M. Clark, of New York, N. Y.

THE EUREKA SMOKE CONSUMER COMPANY, of Rochester, N. Y., has been chartered with a capital stock of $50,000 to manufacture and sell smoke consumers, etc. The incorporators are: John R. Armstrong, Frederick Fish and George Simmons, all of Rochester, N. Y.

THE INDEPENDENT ELECTRICAL SUPPLY COMPANY, of Boston, Mass., has been chartered with a capital stock of $3,500 and the following directors: L. Marcus, president; Max J. Charm, 145 Portland Street, Boston, Mass., treasurer, and S. J. Lipsitz.

THE JOACHUM ELECTRIC COMPANY, of New Orleans, La., has been incorporated with a capital stock of $3,000 by J. A. Douglas, Jr., R. A. Borey and Leon C. Muller. The company proposes to deal in electrical supplies.

THE JOHNSON WIRELESS HOLDING & MANUFACTURING COMPANY, of St. Louis, Mo., has filed articles of incorporation with a capital stock of $100,000, for the purpose of manufacturing and dealing in devices for wireless telephones. The company expects to establish a large laboratory in San Antonio, Tex., for the manufacture of telephones and equipment of a number of wireless stations in that city. The incorporators are: Charles P. Johnson, trustee, Charles P. Johnson, Ralph Jones, Alexander Young, Max F. Ruler and Ralph O. Johnson. Headquarters of the company will be located in St. Louis, Mo.

THE KERMONT INCANDESCENT LAMP COMPANY has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $100,000 and the incorporators are: F. M. Shive, S. E. Roberson and H. W. Davis, of Wilmington, Del.

THE MODEL GENERATOR COMPANY, of Louisville, Ky., has filed articles of incorporation with a capital stock of $7,500. The incorporators are: H. C. Offutt, C. R. Offutt and Oscar Scott.

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, of Jersey City, N. J., has been incorporated by H. H. Flagg, A. B. Trigg and J. R. Turner, of Jersey City, N. J. The company is capitalized at $600,000 and proposes to manufacture and deal in electrical apparatus.

New Incorporations.

BAKER, MINN.—Articles of incorporation have been filed for the Baker & Downer Telephone Company with a capital stock of $1,000 by D. O. Lamb, of Downer, Minn.; G. P. Schneck and W. Cook, of Baker.

SUMMIT, MISS.—The Summit-McComb Motor Line Company has been incorporated with a capital stock of $40,000 to construct an electric railway to connect Summit, McComb and Godbold Mineral Springs, 6 miles in length. The officers are: T. Blackmore, president and treasurer; Dr. V. Simmons, vice-president, and Clem V. Ratcliff, secretary and general manager.

FORBES, MO.—The Business Men's Telephone Company has been incorporated with a capital stock of $3,000 by Elmer Siper, H. E. Milne, G. T. Metcalf and others.

McCONNELLSVILLE, OHIO.—A charter has been granted to the Citizens' Telephone Company of McConnellsville with a capital stock of $20,000. The incorporators are: F. J. Bailey, James Donahue, A. J. Davis and M. D. Davis.

ANTLERS, OKLA.—The Antlers Light & Power Company has been incorporated with a capital stock of $10,000 by J. Easten, Clark Wasson, I. Silverman, Wotten Sliverton and C. Dudley, all of Antlers.

MARSHFIELD, ORE.—The Coos Bay Traction Company has filed articles of incorporation with a capital stock of $1,000,000 for the purpose of building electrical railways from Coos Bay to connect with the transcontinental systems. The incorporators are George M. Perine, George F. Averill, W. B. Campbell and A. T. Harding. The company will also generate and distribute electricity in the towns and villages along the route of its railway lines.

AMITY, PA.—The Amity Farmers' Telephone Company has been chartered for the purpose of building a telephone line from Amity to Dunn's Station, with connecting branch lines. The company is capitalized at $5,000. H. W. Horn, of Amity, Pa., is one of the incorporators.

MILWAUKEE, WIS.—The Badger Railway & Light Company of Milwaukee has been organized to construct an interurban railway from Whitewater to Lake Geneva. The company is capitalized at $10,000 and the incorporators are: H. B. Kamschultze, Gustav Pickhart, Charles Zingsheim, Victor Lachmund and Charles H. Franz, Jr.

Personal.

MR. W. K. BOONE has been appointed general manager of the Jalapa Railroad & Power Company, Jalapa, Mexico.

MR. FRANK NOWLETT, of Fort Wayne, Ind., has been appointed superintendent of the Bath (N. Y.) Electric Light & Gas Company.

MR. L. S. KEDNEY has been appointed superintendent of the electrical department of the Jalapa (Mexico) Railroad & Power Company.

PROF. SYDNEY W. ASHE has been retained by the Harrison Branch of the General Electric Company to expand its educational work in salesmanship and illuminating engineering.

MR. LUDWIG KEMPER has sold out his interest in the Fuel Engineering Company in Chicago and is again acting as general manager for the Albert Lea (Minn.) Light & Power Company.

MR. J. W. THOMAS, formerly of the engineering staff of Westinghouse, Church, Kerr & Company, has been appointed mechanical engineer of the New England Engineering Company, formerly of New Haven and now at 50 Church Street, New York.

MR. L. R. PARKER, formerly with the Westinghouse Electric & Manufacturing Company, has been appointed electrical engineer on the staff of the New England Engineering Company, 50 Church Street, New York.

MESSRS. TRIBUS AND MASSA, consulting engineers, New York City, have been retained to take charge of the completion of the sewer system and sewage disposal works of Monticello, N. Y. This work a short time ago was commenced by Mr. George N. Bell, of Kingston, recently deceased.

MR. F. W. L. PEEBLES has been appointed professor of electrical engineering at Marquette University, Milwaukee, Wis., where he will take over much of the work formerly performed by Dean J. D. Davis. Professor Peebles is a graduate of St. Louis University and for five years had charge of the X-ray laboratory of the Missouri-Pacific Hospital system and as early as 1896 was engaged in X-ray work.

MR. H. A. STRAUSS, vice-president and chief engineer of the Falkenau Electrical Construction Company, Chicago, Ill., has been appointed consulting engineer of the Alton, Jacksonville & Peoria Railway Company, and will undertake the design of the extension of this system to Jerseyville, Ill., involving about twenty miles of roadbed, track, and overhead construction, together with power house.

MR. HORATIO A. FOSTER, who is associated with Bion J. Arnold, of Chicago, is in Los Angeles in connection with the appraisement of some electric properties in that region. Owing to many developments of water power in that particular region, some of these properties spread over a territory extending from the Kern River power house, about 120 miles north of Los Angeles, to Redlands, about 70 miles east of the same city, and to Santa Ana, some 35 miles south.

MR. ARTHUR WILLIAMS, of the New York Edison Company, returned to New York on Aug. 16 after a 10 weeks' sojourn in Europe. While abroad Mr. Williams devoted most of his time to the study of sociological conditions, attending many conventions devoted to considerations of such topics. Incidentally he was able to compare commercial methods in European electric lighting industries to those of the United States and was not a little elated over the superiority of American business-getting methods.

MR. C. G. KILBOURNE has been made assistant in the office of the chief electrical engineer of the New York Edison Company, Mr. Philip Torchio. Graduating from Columbia University, N. Y., in the course of electrical engineering in 1906, Mr. Kilbourne in December of the same year secured a position in the company's laboratory, having charge of the experimental and research work, and testing of the substation electrical equipment. He resigned on July 1 this year as assistant to the chief of the laboratory to accept the present well-earned promotion.

DR. W. H. TOLMAN, director of the American Museum of Safety and chairman of the American Executive Committee of the International Committee on Social Insurance, has been appointed by the State Department a delegate on the part of the United States to the International Congress on Workmen's Insurance to be held at The Hague, Sept. 6 to 9. Among the questions to be discussed are the extension of social insurance to include others than workmen, that is, small tradespeople, shop keepers and farmers; provisions for widows and orphans by means of insurance and insurance against unemployment.

MR. L. D. GIBBS, secretary-treasurer of the New England Section of the National Electric Light Association, is exceptionally qualified for the work of that position by former experience in secretarial and newspaper work. Mr. Gibbs was born in St. Johns, Mich., and after graduation from the high school, taught himself shorthand, clerked in numerous stores and spent the greater part of a year driving a delivery wagon in Denver and "rustling" in the mining camps of Clear Creek County before he settled down again in his home town to run a newspaper, *The St. John News*. After a couple of years he decided he should get a college education, and upon graduation became a reporter on the *Springfield Republican*, of Springfield, Mass. Later, he spent three years in Washington doing secretarial and committee clerkship work in the House of Representatives, but devoted the most of his time to newspaper work, representing during the first year, the *Springfield Republican* and the last year was assistant Washington correspondent for the *Boston Transcript*. During the presidential campaign in 1904 he had charge of the suburban newspaper publicity work in the Literary Bureau of the Republican headquarters. Four years ago he accepted the opportunity that was opened for "a man with some newspaper experience" to join the staff of solicitors in the Edison Electric Illuminating Company, of Boston. On July 1 last, upon the retirement of Mr. Converse D. Marsh as advertising expert for the Boston Company, he was made superintendent of advertising. Mr. Gibbs was secretary of the New England Section of the Illuminating Engineering Society from January, 1909, to February, 1910.

MR. L. D. GIBBS.

Obituary.

ALBERT SPIES.—We regret to announce the death of Mr. Albert Spies, who died of pneumonia, Aug. 16, at his home in Jersey City. Mr. Spies was born in New York City, July 20, 1862, and was graduated from Stevens' Institute of Technology with the degree of M.E., in 1881. For two years after graduation, he was an associate editor of *The Iron Age*, and later became editor of *Mechanics*. After engaging in engineering practice for some years, he became, in 1893, the editor of *Cassier's Magazine*, which position he retained until after the death in 1906 of the owner of that journal. From 1907 to 1909 he was editor of *The Electrical Record*, and at the time of his death was editor and proprietor of *Foundry News*, the publication of which began only a few months ago. Mr. Spies was a member of the American Institute of Mining Engineers, member of the Society of Mechanical Engineers, associate member of the Institute of Electrical Engineers, and member of the Engineers' Club, of New York. He is survived by a widow and one son.

MR. THEODORE P. BAILEY, Assistant Manager of the General Electric Company, Philadelphia District, died at his home in Mount Airy, Philadelphia, after an operation for appendicitis, and was buried on Tuesday morning, Aug. 23. Mr. Bailey was born in Covington, Ky., Aug. 17, 1856, and after receiving his education in the public schools at Princeton, Ill., engaged in newspaper work at that place. Taking up the study of stenography, he became a court reporter at Morris, Ill., in 1879, which work he later continued at Joliet, Ill., at the same time pursuing the study of law. In 1881 Mr. Bailey was admitted to the bar and shortly afterward removed to Chicago, where he became associated with Gen. A. K. Stiles. General Stiles and Mr. Norman T. Gazette were the

original promotors of the Vandepole Electric Company, in which Mr. Bailey became interested, and thereafter turned his attention to electrical matters. In 1885 he was made western representative of the Thomson-Houston Company, and after its merger with the General Electric Company, he continued in charge of the street railway business in the Chicago district, later becoming assistant manager of that office. In 1905 he resigned to enter the railway contracting business, as vice president and general manager of the L. E. Myers Company, Chicago, with which he remained until 1907. After about a year in charge of the Auto Department of the St. Louis Car Company, Mr. Bailey, in the fall of 1908, returned to the General Electric Company as assistant manager of the Philadelphia district. For many years Mr. Bailey was one of the most widely known men in the street railway circles of the west, and was among the first to project electric light systems in that section, having been interested in establishing the first installations in such cities as Des Moines, Omaha, St. Louis, Kansas City, Minneapolis and St. Paul. He is survived by a widow and one child.

Trade Publications.

COUPLINGS.—The General Electric Company has issued Bulletin No. 4750, describing shaft couplings adapted for coupling electrical apparatus together, or to other machinery. The types described are the leather-link flexible coupling, laced-belt coupling, rubber buffer coupling and flange coupling.

SWITCHES.—Dr. Paul Meyer, N 39 Lynarstr. 5-6, Berlin, Germany, has issued, as sheets to the 1910 catalog, illustrated price-lists of 550-volt, manually-operated switches and automatic circuit-breakers for direct and alternating current, arranged for electro-motive forces not exceeding 550 volts.

AUTOMATIC TELEPHONES.—The automatic telephone system designated by the title "Autophone" is briefly described in a folder of S. H. Couch, 156 Purchase Street, Boston. The folder contains an outline of the advantages and disadvantages of this system in comparison with the manual switchboard system.

COAL-HANDLING MACHINE.—A 400-page publication dealing with coal-handling and ash-handling apparatus has been issued by the Link-Belt Company, Philadelphia, Pa., as its catalog No. 90. This book is well illustrated throughout, views being given not only of the constructive details, but of completed equipments.

BALL BEARINGS.—The Hess-Bright Manufacturing Company, Philadelphia, Pa., is distributing for insertion in its loose-leaf catalog sheets 52 and 53, containing much valuable data relating to ball bearings for heavy service. A thrust bearing intended particularly for service of marine nature is illustrated and described in sheet 53.

TELEPHONE SWITCHBOARDS.—Many of the details embodied in the construction of central battery non-multiple switchboards with lamp signals are shown in bulletin No. 1004 of the Western Electric Company. The switchboards described in this bulletin are intended for exchanges where the ultimate number of subscribers' lines will not exceed 500.

DIRECT CURRENT SWITCHBOARDS.—Switchboards designed for direct current service at electromotive forces of from 125 to 250 volts are briefly described and illustrated in bulletin No. 33 of the F. Bissell Company, 226 Huron Street, Toledo, Ohio. In this bulletin are listed also the numerous elements used in the construction of the switchboards.

SWITCHES.—The Agutter & Griswold Company, 411 Occidental Avenue, Seattle, Wash., is distributing its general catalog, devoted to knife switches, fuses, panel boards and switchboard instruments. The catalog is a well-executed publication of 126 pages. It contains outline illustrations, brief descriptions and list prices of the various types of devices described.

DIRECT-CURRENT MOTORS.—Bulletin No 193 of Roth Brothers & Company, Adams and Loomis Streets, Chicago, is devoted to direct-current motors ranging in rating from 4 hp to 30 hp. Bulletin No. 199 of the same company deals with motors designed particularly for use with band saws, for cutting either wood or metal. These motors are arranged for complete enclosure.

DIRECT-CURRENT INSTRUMENTS.—The General Electric Company has issued Bulletin No. 4760, illustrating and describing a line of direct-current instruments. The illustrations comprise external and internal views of the instruments, showing the details of construction, together with dimension diagrams of the instruments and the shunts; the scales used for different ratings are also shown.

FLOOR OUTLETS.—Bulletin "B" of the Steel City Electric Company, 1207 Washington Avenue, Pittsburg, Pa., gives detailed information concerning floor outlets and the auxiliary apparatus used therewith. The outlets described are of the self-adjusting type, being so designed as to present a smooth surface for the floor, quite independent of the position of the main body of the outlet box.

ELECTRIC SIGNS.—Electric signs of the sparkle type are described and illustrated in bulletin No. 60 of Betts & Betts, Heidelberg Electric Tower, 42d Street and 7th Avenue, New York. The electric sparkle sign is offered as a substitute for the ordinary electric letter sign, and is said to give the desired effect at night at a much lower cost, and to possess a superior appearance in the day time.

TACHOMETERS.—James G. Biddle, Philadelphia, has issued a special tachometer bulletin (No. 716), relating to Frahm vibration tachometers and Ja-Ga-Ba hand tachometers. The former type is built on the resonance plan and is especially suited for high-speed turbines and generators. Ja-Ga-Ba tachometers are made on the centrifugal principle, and combine compactness with convenience in use and accuracy in results.

PRINTING PRESS MOTOR DRIVES.—Bulletin No. 505-G of the Garwood Electric Company, Garwood, N. J., contains a good description of the methods which may be employed for driving printing presses by means of electric motors. Much of the information given in this bulletin is of an engineering nature, and the bulletin should prove of service to those interested in the application of electricity to print-shop machinery.

THE ELECTRIC LIGHTING OF AUTOMOBILES.—The Engineering Department of the National Electric Lamp Association, Cleveland, Ohio, has issued bulletin No. 12, dealing with the use of electric lamps for automobiles. The bulletin does not partake of a trade nature, but contains much technical information, concerning the operating characteristics of incandescent electric lamps, especially those of the miniature type.

POWER STATION ERECTION.—Much interesting information relating to the architectural features of modern power stations is given in a neatly executed bulletin sheet by the Stone & Webster Engineering Corporation, Boston, Mass. Outlined descriptions are given of the Lincoln Power Station, the Harvard Power Station, and the Charlestown Power Station, which have recently been erected in the Boston neighborhood.

ILLUMINATION.—The Nernst Lamp Company, Pittsburg, Pa., has published as example No. 1 of modern merchandising establishments a description of the installation of Marshall Fields Company, Chicago. The lighting equipment used in each department is described in detail. The average consumption throughout the different floors varies from 0.8 watt to 2.3 watts per square foot, and the mean illumination varies from 2.0 to 6.8 foot-candles.

REFRIGERATION.—The Triumph Ice Machine Company, Cincinnati, Ohio, has issued bulletin 508 giving a detailed description of machines for manufacturing ice. Particular attention is directed to the advantageous features of ice making as a profitable day load for central stations. Bulletin 501 of the same company is a 35-page publication, giving numerous details relating to the constructive features of compressors for use in connection with the manufacture of ice.

SERIES INCANDESCENT SYSTEMS.—Bulletin No. 4718 of the General Electric Company deals with the apparatus required for a complete series incandescent lighting system. The illustrations include Mazda tungsten lamps for street lighting with various forms of reflectors and suspension insulators, street system brackets, constant-current transformers, panel boards, socket cut-outs and ornamental poles, as well as complete dimension and connection diagrams and illumination curves.

WIRING DATA.—The Pettingell-Andrews Company, Boston, is distributing booklets containing much valuable data relating to wires and installation of electrical circuits. In addition to the various gages, tables are given of conductivities of various metals and alloys, the conduits for different sizes of wires, specifications for standard wiring symbols, metric equivalents, wiring formulas for both direct current, alternating current circuits and instructions for the care and installation of motors and generators.

LUMINOUS ARC RECTIFIER SYSTEMS.—In its Bulletin No. 4752 the General Electric Company gives much information concerning rectifier sets, luminous arc lamps and the auxiliary apparatus for complete series luminous arc rectifier systems. The bulletin is fully illustrated and shows views of the exterior and the mechanism of the luminous arc lamp, as well as the series vertical electrode flame arc lamp for operation in series with luminous arc lamps. Luminometer chart, illumination curves and wiring diagrams are also shown.

BUILDING CONSTRUCTION.—The Stone & Webster Engineering Corporation, Boston, Mass., is distributing mailing cards showing by means of photographs the rapidity with which the company was able to construct the White Building in Seattle. It is claimed that this building was ready for tenants within 10 months after construction was begun. On a separate mailing card is shown a view of the Georgetown power station of the Seattle Electric Company, which contains a 16,000-hp equipment installed by the Stone & Webster Engineering Corporation.

ICE-MAKING MACHINERY.—In its catalog "A" The Vilter Manufacturing Company, Milwaukee, Wis., discusses at considerable length the equipment required in the manufacture of ice, and arrangements which may be employed for installing this machinery most conveniently. The publication contains numerous sectional drawings of existing installations, and should prove of considerable value to central stations. This company has issued a 63-page booklet containing a partial list of the users of ice-making and refrigerating machinery which it has manufactured.

INTENSIFIED ARC LAMPS.—The General Electric Company has issued publication No. 4742, devoted to general illumination by its intensified arc lamp. The publication contains a description and illustrations in considerable detail of a lamp designed for general illuminating purposes, which is simple mechanically, and reliable in operation. The principal characteristics of the lamp, however, are its high efficiency and the color-value of its light. The publication contains a color chart showing the illuminating values of various forms of lighting as compared with daylight. This chart compares the incandescent, Welsbach, Nernst and the arc with daylight.

BUSINESS NOTES.

MR. A. F. NORCROSS has succeeded Mr. Hubert S. Collins as general manager of the Engineering Supervision Company, 45 West Thirty-fourth Street, N. Y. City.

THE WHEELER CONDENSER & ENGINEERING COMPANY, Carteret, N. J., has acquired the patterns and drawings of the "Conover" condenser and will hereafter manufacture that apparatus.

THE NEW ENGLAND ENGINEERING COMPANY has removed its engineering offices from New Haven, Conn., to 50 Church Street, New York. The staff has been increased by the addition of Mr. J. W. Thomas, mechanical engineer, formerly of Westinghouse, Church, Kerr & Company, and Mr. L. R. Parker, electrical engineer, formerly of the Westinghouse Electric & Manufacturing Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 16, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

967,151. INDICATOR FOR ARC LAMPS; J. H. Allen, Chicago, Ill. App. filed Jan. 23, 1908. An indicator for arc lamps consisting of a trigger tripped by the carbon to get a signal when the carbons require trimming.

967,159. METHOD OF REDUCING ORES; F. M. Becket, Niagara Falls, N. Y. App. filed March 24, 1908. Passes an electric current by means of a metallic electrode into a molten bath containing a metal and a reducing agent and cools the electrode to protect it from the bath and reduction products.

967,160. MACHINE FOR BLACKLEADING MOLDS FOR ELECTROTYPING; G. H. Benedict, Chicago, Ill. App. filed Jan. 7, 1910. A reciprocating frame with a rotatable plate which carries a matrix and is partially rotated at each reciprocation of the frame so as to discharge a fluid upon the matrix at an angle thereto.

967,171. LOW-SPEED CIRCUIT CONTROLLER; F. B. Corey, Schenectady, N. Y. App. filed May 20, 1909. For controlling the circuits of lock magnets for levers controlling railway switches and signals including a worm and worm wheel driving mechanism.

967,186. CONTROL SYSTEM FOR ELECTROMAGNETS; J. H. Hall, Cleveland, Ohio. App. filed May 13, 1910. For lifting magnets for moving billets in which a master switch is used in connection with a magnet having an energizing winding, the connections causing currents to flow successively through the winding so as to demagnetize it with means for limiting the value of the demagnetizing current.

967,192. RELAY FOR BLOCK SIGNAL SYSTEMS; L. A. Hawkins, Schenectady, N. Y. App. filed March 4, 1908. A movable contact member having operative operations on both sides of its off position with means for engaging the member to hold it in off position and a locking member controlled by the current and the relay for locking the contact member in the off position.

967,190. SWITCH FOR ELECTRIC TOOLS; L. A. Hauck, Cincinnati, Ohio. App. filed Jan. 27, 1909. For portable electric tools comprising terminals and the movable contact for breaking the circuit between them with a thumbpiece for operating it.

967,200. ELECTROLYTE AND METHOD OF ELECTRO-DEPOSITING ZINC; E. F. Kern, Knoxville, Tenn. App. filed Sept. 1, 1909. For electrolyte consists of a salt of zinc, a salt of aluminum, an organic substance and a salt of ammonium.

967,204. MAGNETO TELEPHONE; O. M. Leich, Genoa, Ill. App. filed June 19, 1908. A wall telephone with cabinet and door in which the ringer is mounted near the top and below the induction coil, below which is the transmitter, below which a large space is left for the condenser. The back of the cabinet need not carry conductors.

967,210. ELECTRIC MOTOR CONTROL; L. V. Lewis, Wilkinsburg, Pa. App. filed April 9, 1910. A transformer connected with the field and armature with means for controlling the direction of current through the transformer so as to control the direction of rotation of the motor.

967,217. TRANSMITTER; H. S. Mattison, La Crosse, Wis. App. filed March 22, 1909. A circular diaphragm with an annular groove and a gasket in the groove and between the diaphragm and case and a spring pressing the diaphragm toward the case.

967,222. RELAY; D. J. McCarthy, Wilkinsburg, Pa. App. filed March 5, 1910. For automatic signaling systems employing alternating current in tract currents, including a vane assuming three positions under the influence of two magnetic fields.

967,233. ELECTRIC INCANDESCENT LAMP AND CONNECTIONS THEREFOR; W. J. Phelps, Decd., Detroit, Mich. App. filed July 15, 1907. Lamps with connections and controlling switches for dimming by means of a resistance coil contained in the flexible cord leading to the lamp.

967,237. ELECTRIC HOIST; A. Rausch, Berlin, Germany. App. filed March 2, 1910. Electrically operated hoist driven by an alternating motor with a controller having a braking position so as to cause the motor to act as a braking generator driven by the load with means for stopping the hoisting movement.

967,240. COIL SUPPORTING STRUCTURE FOR DYNAMO-ELECTRIC MACHINES; J. T. Roberts, Wilkinsburg, Pa. App. filed Nov. 6, 1908. For supporting high-speed armature coils by means of an inner ring and an outer ring with annular baffle plates secured to the brackets to form an air chamber through which air is driven by a fan carried by field magnets.

967,254. TURBO-GENERATOR CONSTRUCTION; C. H. Smoot. App. filed Jan. 2, 1906. A cylindrical core with lengthwise slots each carrying an insulated conductor and end discs for interconnecting them.

967,276. MICROTELEPHONE; J. N. Wallace, La Crosse, Wis. App. filed March 22, 1909. Includes a handle with a receiver and a transmitter, the handle consisting of two half tubes and two binding members to hold them together, the receiver and transmitter being attached to one half.

967,280. MAGNETIC BLOW-OUT; H. E. White, Schenectady, N. Y. App. filed Feb. 4, 1910. A blow-out magnet in which the coil is placed in series with the arc to produce a field to blow the arc.

967,281. MAGNETIC BLOW-OUT; H. E. White, Schenectady, N. Y. App. filed Feb. 4, 1910. The field produced by the current confines the arc near the center of the contact, the contacts being shaped to cause the current to have a movement transverse to the arc chute.

967,295. BRAKING ALTERNATING-CURRENT MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed June 4, 1906. Connects the armature to the source and impresses on the field of the motor a voltage displaced 90 deg. from the voltage of the source, and controls the phase of the voltage to vary the braking effect..

967,296. ELECTRIC BRAKING; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 19, 1908. Operates a portion of the motors as separately excited generators driven by the load, and operates other motors in the same way, but excited by currents generated in the first-named motors.

967,323. CLUTCH ARRANGEMENT FOR ARC LAMPS; T. L. Carbone, Berlin, Germany. App. filed March 5, 1907. Includes a pair of plates loosely pivoted to a vertically oscillating rod, one end having holes for the carbon and acting as a clutch.

967,325. WIND-WHEEL ELECTRIC GENERATOR; A. Carlson, Klamath Falls, Ore. App. filed Aug. 9, 1909. A driving shaft drives a countershaft by means of a worm gear, the latter carrying an armature disc.

967,361. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, Eng. App. filed Jan. 29, 1909. Single-phase induction motor with an induced winding closed on itself independently of a commutator with a neutralizing winding on the inducing member connected with the commuted winding so that the current passing through one will bear a constant ratio to the current passing through the other.

967,362. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, Eng. App. filed May 8, 1909. The stator has a main inducing winding and the rotor a commuted winding, and a second winding is closed on itself with a magnetic shunt forming a pathway for magnetism to link with the commuted winding without linking with the second winding, and means for directing the flow of current in the commuted winding along two axes.

967,363. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, Eng. App. filed July 9, 1909. A squirrel-cage winding and a commuted winding on the induced member, both windings being on the periphery of the motor with short-circuited brushes on the commuted winding in the axis of the inducing winding and connected in series with the inducting winding along another axis.

967,386. SYSTEM OF CONTROL FOR ALTERNATING DIRECT-CURRENT MOTORS; R. P. Jackson, Wilkinsburg, Pa. App. filed Dec. 18, 1905. For railway systems including a source of alternating currents, direct currents, translating devices operated by either current, switches for the circuit connections controlled by magnets and energized in a predetermined order when operated by alternating current and in another order when operated by direct current.

967,387. SYSTEM OF CONTROL FOR ALTERNATING DIRECT CURRENT MOTORS; R. P. Jackson, Wilkinsburg, Pa. App. filed Dec. 18, 1905. See 967,386. A non-inductive resistance between a controlling magnet winding for the circuit switch and a transformer whose primary is in series with the resistance, and the secondary supplies current to the other controlling magnets of the circuit switch.

967,388. ELECTRICAL CUT-OUT DEVICE; R. P. Jackson, Wilkinsburg, Pa. App. filed March 3, 1906. Fuse holding terminals, a fuse mounted therein and a casing open at the bottom whose sides support the terminals.

967,389. ALTERNATING DIRECT-CURRENT SYSTEM OF CONTROL; R. P. Jackson, Wilkinsburg, Pa. App. filed Dec. 18, 1905. For railway systems in which alternating motors may also be operated by direct current. See 967,386.

967,398. MECHANICAL CONTROLLER FOR ELECTRIC CURRENTS; D. L. Lindquist and D. Larson, Yonkers, N. Y. App. filed Oct. 30, 1907. Motor controlling apparatus for hand-rope control of alternating-current elevators, including a reversing switch operated by a rotary cam with one or more accelerating switches.

967,404. OUTLET BOX; N. Marshall, Newton, Mass. App. filed Oct. 31, 1908. For interior conduits, the box having two walls at right angles with an aperture through one wall and a union and screw-threaded connector held from turning by engagement with the other wall.

967,409. TELEPHONE SIGNAL ATTACHMENT; W. F. Mikolasek, Scotland, S. D. App. filed March 9, 1909. Party line telephone selective system with a switch for consecutively closing the talking circuit and the call circuit and opening the latter with the opening of the ringing circuit and the closing of the receiver circuit.

967,469. X-RAY APPARATUS; H. F. Waite, New York, N. Y. App. filed July 5, 1906. An X-ray tube housing is mounted on horizontal pivots in slides and is counterbalanced by weight connected to the slides.

967,474. BRUSH HOLDER; R. B. Williamson, Milwaukee, Wis. App. filed Oct. 6, 1909. Includes a clamp having two parts engaging a stud secured diagonally with a pivoted arm secured to one part and a brush carried by the arm.

967,475. TELEPHONE SYSTEM; C. W. Winston, Chicago, Ill. App. filed Nov. 22, 1907. A system including a pair of telephone lines, a cord circuit with calling and answering signals and four relays, one in each end of each talking strand with switches under the operator's control for two of the relays which actuate the supervisory signals and switches under the subscriber's control for the other two relays for effacing the signals.

967,476. TELEPHONE SYSTEM; C. W. Winston, Chicago, Ill. App. filed Nov. 22, 1907. Central battery system with an impedance coil in a bridge of the talking strands of the cord circuit and a second relay with its coil normally in series with one of the talking strands with a shunt depriving the second relay of actuating current and completing a non-inductive path for voice currents.

967,508. ELECTRIC LIGHT BUTTON; J. Fortas and J. R. Jackson, Memphis, Tenn. App. filed Dec. 3, 1909. A turned button, having a chamber with a clasp therein having flat jaws and the tongue extending out from one end of the chamber.

967,527. BRUSH HOLDER; E. R. Knight, Norwood, Ohio. App. filed Feb. 4, 1905. A slotted guideway of sheet metal, with carbon engaging the slotted face of the guideway carrying a shoe with wings parallel to the face of the carbon and engaging the guideway.

967,574. APPARATUS FOR AGING LIQUORS; J. Seitz, Chicago, Ill. App. filed July 13, 1908. Electrolyzes the liquid by an electrode carried by a bung which carries a non-conducting tube in which the wire electrodes are mounted.

967,575. LIQUOR AGING AND PROCESSING APPARATUS; J. Seitz, Chicago, Ill. App. filed Feb. 3, 1909. Electrolyzes liquids by means of a threaded plug with an insulating sleeve and a conducting point projecting from the sleeve, the apparatus entering a barrel containing the liquid.

967,578. ART OF ELECTRIC WELDING AND REPAIRING; H. L. J. Siemund, New York, N. Y. App. filed June 3, 1909. A clamp for electric arc welding having a magnetizing coil and holding a piece of the welding metal.

967,579. METHOD OF ELECTRIC WELDING AND REPAIRING; H. L. J. Siemund, New York, N. Y. App. filed Jan. 19, 1910. Establishes an arc between the metallic object and the end of a rod of the repairing metal used, the heat of the arc beginning the fusion.

967,590. MANUFACTURE OF STEEL; W. R. Walker, New York, N. Y. App. filed April 21, 1906. Treats molten iron in a Bessemer converter, then pours the metal through basic slag for removing phosphorus, and then treats the metal in an electric furnace.

967,597. DIFFERENTIAL GALVANOMETER; J. L. Zander, Newark, N. J. App. filed March 16, 1910. A pair of horseshoe magnets with a wire would coil about the pole of each magnet and movable relatively thereto, the poles tapering.

967,631. ELECTRIC TERMINAL; E. Gerhardt, Jr., Mauer, near Vienna, Austria-Hungary. App. filed Oct. 15, 1908. A body of insulation receiving a conductor with an integral projection extending beyond the opening and engaging the insulating support and holding the terminal in the support.

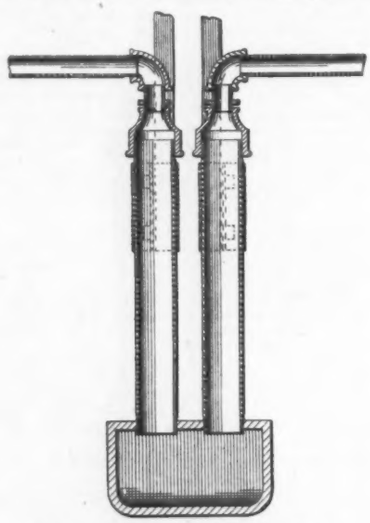
967,632. COMBINED JUNCTION BOX AND CUT-OUT AND SWITCH SUPPORT; W. J. Gibbons, Philadelphia, Pa. App. filed June 2, 1909. The parts are supported with a single base.

967,633. CIRCUIT MAINTENANCE SYSTEM; A. Goldstein, New York, N. Y. App. filed Jan. 22, 1906. For establishing the circuit around a brake by means of magnets and circuit breakers in the ground connection of each armature of each magnet, which ground is removed when another ground is established.

967,649. MEANS FOR VISIBLY INDICATING FAULTY INSULATORS; C. Linke, Strassburg, Germany. App. filed June 30, 1909. Hollow rings of celluloid which is inflammable pass around the insulator below the wire and are dissipated by the arc on short circuiting.

967,658. FIRE ALARM; F. E. Oviedo, Mexico, Mex. App. filed July 2, 1909. A weight suspended by cords held by fusible material which falls so as to close an electric circuit and give the signal.

967,681. ELECTRICAL TRAIN SYSTEM; J. R. Sloan, Altoona, Pa. App. filed Nov. 16, 1906. For train lighting systems, for wiring the several cars, including a flexible conductor carrying contacts and carried by separate cars, the contacts pressing against each other with



967,159.—Method of Reducing Ores.

spring pressure tending to separate the terminals and means for automatically releading the retaining mechanism for the contacts.

967,684. ARC LAMP; C. H. Sprague, Newton, Mass. App. filed July 16, 1908. For regulating the feed of the electrodes by means of a flexible strip of fusible material with two downwardly extended rods having grooves to contain these strips, the latter being guided at a point near the arc with means for supporting one of the electrodes by the fusible strips so as to prevent it from feeding until the strip is heated, causing it to yield at its lower end.

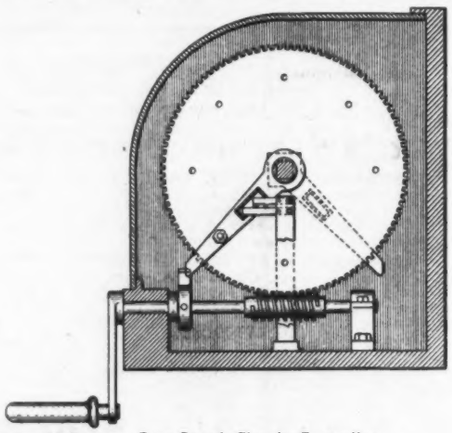
967,692. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Jan. 22, 1907. Lockout system with a plurality of substations on the line each with two normally open branches in the bridge of the limbs of the line with a transmitter, relay, manual switch and winding of an induction coil in one branch at each substation and a receiver, another winding of the induction coil and a contact for the relay in a local circuit at each substation.

967,719. TELEPHONE NOISE EXCLUDER AND CURRENT SAVING DEVICE; W. E. Burt, Uba, Wis. App. filed May 11, 1910. An attachment for holding the receiver hook at a point where the battery circuit is broken and the talking current completed by means of a gravity-returned retaining hook engaging the receiver hook.

967,738. ELECTRIC ARC LAMP; T. J. Digby, London, Eng. App. filed Sept. 8, 1908. For stage lighting in which the light is regulated by shutters with a V-shaped notch in each, which overlap so as to vary the size of the opening.

967,747. TRANSMITTER MOUTHPIECE; O. F. Falk, Belleville, N. J. App. filed July 13, 1909. A cone-shaped shield is inserted in the mouthpiece of the transmitter with its point toward the mouth and leaving a channel between the rim of the cone and the mouthpiece.

967,748. TELEPHONE DICTATING MACHINE OR APPARATUS; O. F. Falk, Belleville, N. J. App. filed July 13, 1909. For dictating from a central manager's desk selectively to any one of a corps of



967,171.—Low-Speed Circuit Controller.

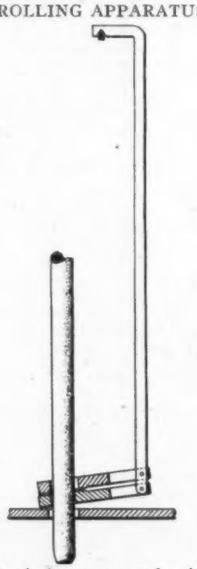
stenographers, the manager's instrument including a box with an inside frame supporting keys and signals with a swinging frame carrying the transmitter and receiver.

967,753. SWITCH FOR ELECTRIC LIGHT SOCKETS; C. D. Gervin, New York, N. Y. App. filed Oct. 22, 1909. A pull-cord switch in which the switch arm is mounted on a shaft having an angular portion with a pawl in engagement with the sides of the angles.

967,762. PROCESS OF FORMING GLUE FROM LEATHER; H. G. Halloran, Brighton, Mass. App. filed Dec. 27, 1909. Treats the leather with a salt solution by electrolysis, then washes, etc.

967,773. PRIVATE BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM; N. H. Holland, Chicago, Ill. App. filed Nov. 23, 1907. For answering a call over a trunk line at any one of several stations without causing a disconnect signal at central while using the telephone for communicating with a local station.

967,782. MOTOR CONTROLLING APPARATUS; S. H. Keeper, Plain-



967,323.—Clutch Arrangement for Arc Lamps.

field, N. J. App. filed April 14, 1910. For controlling reversing motors by means of a magnetic switch actuated by a pilot switch which controls the solenoids of the magnetic reversing switch.

967,847. REGULATOR; L. R. Smith, Chardon, Ohio. App. filed April 6, 1909. For automatically regulating the flow of liquid from a vessel, after the liquid has reached a given temperature by means of an electric controller which moves a valve which controls the outlet, the controller being operated through a thermal circuit closer.

967,862. CONDUIT ROD OR COUPLING THEREFOR; E. L. Upson and F. J. Dole, New York, N. Y. App. filed Sept. 11, 1908. For carrying wires through conduits, each rod having at both its ends a coupling socket, each socket symmetrical and carrying locking means and a single wheel on each socket, thus providing a pair of wheels at adjoining sockets.